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MAP OF NEW JERSEY,

Illustrating Dr. Hollick's paper.

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THE RELATION BETWEEN FORESTRY AND GEOLOGY IN NEW JERSEY.

ARTHUR HOLLICK.

I. PRESENT CONDITIONS.

THE problems of plant distribution, or, in other words, the reasons why certain species, genera, or classes of plants occupy certain regions, have long received attention from those who have observed the facts. If the earth as a whole be viewed in connection with the entire vegetable kingdom, it is at once apparent that the most powerful factor in limiting the distribution of plants is climate, and that isothermal lines are closely identified with lines of plant limitation. If, however, smaller geographic areas and smaller aggregations of plants be considered, it will at once be seen that climatic conditions alone are not sufficient to account for all the facts of distribution and limitation which obtain, but that physiographic conditions, including altitude, presence or absence of moisture in the ground and atmosphere, surface configuration, etc., are among the factors which are the most influential. Finally, it may be noticed that there are some facts of distribution which are more or less independent of both climatic and physiographic condi-

tions. They appear to depend upon soil characteristics, either mechanical or chemical, and these characteristics constitute what may be termed the geologic factor, for the reason that the nature of the soil in any locality is directly dependent upon the nature of the geologic formation in that locality. It is with this phase of the subject that this paper is specially concerned.

It is unfortunate that by far the greater number of areal investigations which have been undertaken have been restricted by artificial boundaries, generally political, such as state or country lines, instead of having been extended to their natural limits, either physiographic or geologic, and many interesting problems, for this reason, have been only partially solved or outlined.

In New Jersey two distinctly defined forest zones have long been recognized,[1] *viz.*, a deciduous and a coniferous — the contrast between the two being so obvious as to attract the attention of even a superficial observer. On first sight the fact that the former zone is roughly confined to the northern part of the state, and the latter one to the southern part, might seem to indicate that the limits of the zones were determined by purely climatic conditions. If, however, the line of demarcation between them be followed across the state, or, better yet, beyond the confines of the state, it will at once be apparent that it does not coincide with any parallel of latitude or with any isothermal line, and also that it is not entirely dependent on topography or the physiographic conditions.

If, however, a geological map of the region be examined, the line of demarcation between the two zones will be seen to parallel very closely the general trend of the geologic formations, whose outcrops extend in a northeast and southwest direction across the state and southward beyond; and the inference is natural that this coincidence is not accidental, and that the reasons for it must be taken into account in studying the problem of the limitations of the zones.

[1] For a brief discussion of the subject, see Dr. N. L. Britton's Catalogue of Plants found in New Jersey, introductory chapter, *Final Report State Geologist*, vol. ii (1889), pt. i.

It was from this point of view that investigations were commenced, and as they proceeded it became more and more apparent that not only were the two great classes of angiosperms and gymnosperms strongly identified with certain geologic formations, but also that the distribution of many species within each of the zones was capable of being similarly identified, and their limits more or less accurately defined.

This line of investigation could, of course, be almost indefinitely extended, so as to include a much larger number of species, and if the entire flora of the state could be written up from the same standpoint, an exceedingly interesting contribution would result. If, further than this, the investigation could be made to cover a natural geologic area, instead of an artificial political one, the value of the work would be correspondingly enhanced.

The above-mentioned facts having been recognized by preliminary exploration, steps towards more detailed investigation were taken by traversing the state in a series of routes as nearly as possible at right angles to the trend of the geologic outcrops, thus crossing these in succession and noting whatever changes in the vegetation were apparent from place to place.

In pursuing the investigations in this manner the following facts were ascertained:

If an irregular line be drawn between Woodbridge and Trenton, and a similar one between Eatontown and Salem, the typical deciduous zone will be found to lie north of the former, and the typical coniferous zone south of the latter, while between the two is an area about sixteen miles wide, which may be termed the "tension zone," because it is there that the two floras meet and overlap, producing a constant state of strain or tension in the struggle for advantage.[1]

Within the limits of the deciduous and coniferous zones the conditions are more or less uniform; the typical or characteristic species in each have become firmly established in the environment most favorable to their growth, or unfavorable for others,

[1] An excellent general discussion of floral tensions may be found in Mr. Conway MacMillan's Metaspermæ of the Minnesota Valley, pp. 594–600, *Repts. Geol. and Nat. Hist. Sur., Minn.* Botanical Series I. 1892.

and the struggle for existence is largely between individuals of the same species. In the tension zone, however, the struggle is not only between individuals of the same species, but also between individuals and aggregations of different species. The elements in the deciduous flora are always ready to seize upon any advantage which will give them a foothold further south, while the elements in the coniferous flora are always ready for an opposite move. The former is a southward-moving, the latter a northward-moving flora. In consequence of these conditions, the area between their borders is in a state of unstable equilibrium, so far as its vegetation is concerned. The tension is constant, and any change in or interference with the environment releases the tension and causes a disturbance of the relations between the two floras until new conditions have become established. Each such disturbance is marked to a greater or less extent by changes of species, and lines of limitation thus vary from time to time.

The influence of civilization has been the most marked factor in this connection. Fire and cultivation have caused, directly and indirectly, great changes in the interrelations of species. In places certain species have been removed for economic purposes, and other species, less valuable, allowed to remain undisturbed; and this gives at once a direct advantage to the latter in the subsequent struggle for place. In other localities all species have been removed, and such a change wrought in the environment that foreign species, better able to adapt themselves to the new conditions, become established there.

Fire is probably the most destructive agency, as it not only destroys the living vegetation above ground, but often also the roots and seeds beneath. It is also to be borne in mind that in poor soil, such as obtains in the pine barrens, the ruin is more complete than in richer soil. In the latter case the soil will soon recuperate and be in a condition to start and nourish a new growth by reason of the diverse elements contained in it; but in the case of a sand or gravel soil, almost entirely composed of quartz, practically all the plant food is concentrated in the surface layer of humus, which has been slowly built up by the growth and decay of the vegetation itself, and when this is

destroyed the process of again enriching the soil is an exceedingly slow one. Fire-swept areas in the coniferous zone are, therefore, naturally barren for a much longer time than are similar areas in the deciduous zone. A corollary to the foregoing propositions is that changes wrought within the limits of the deciduous or coniferous zones would not normally lead to such extensive changes in species as would be the case under similar circumstances within the limits of the tension zone. In the former instances the original species would be likely to reappear again, as their relatives would be their nearest neighbors. In the latter instance, however, any change might afford just the advantage which some species of one of the border zones required for their establishment in new territory. It is in the tension zone, undoubtedly, that the greatest change in species and in the limits of species, has occurred, especially since the advent of civilization, as it is there that cultivation has been extended over the greatest area. In the marl belt the original forest was destroyed at a very early period, on account of the value of the soil for farming purposes, so that we do not know just what was the original condition throughout that region; but the indications are that coniferous trees were formerly more abundant than they are now, both in actual numbers and relatively to the deciduous trees; while in the bordering zones the relative proportions of the several species have probably always been about the same as now.

In the following table an attempt has been made to give an idea of the general character of the forests in the deciduous and coniferous zones by listing the species which were found to be the most conspicuous and characteristic in each.

DECIDUOUS (NORTHERN) ZONE.

Gymnospermæ: *Pinus Strobus* L., *Tsuga Canadensis* (L.) Carr., *Juniperus Virginiana* L.

Angiospermæ: *Juglans nigra* L., *Hicoria ovata* (Mill.) Britton, *H. glabra* (Mill.) Britton, *H. alba* (L.) Britton, *Carpinus Caroliniana* Walt., *Betula lenta* L., *B. lutea* Michx. f., *Fagus atropunicea* (Marsh.) Sudw., *Castanea dentata* (Marsh.) Sudw., *Quercus Prinus* L., *Q. rubra* L., *Q. coccinea* Wang., *Q. velutina* Lam., *Q. alba* L., *Ulmus Americana* L., *Liriodendron tulipifera* L., *Platanus occidentalis* L., *Cornus florida* L., *Rhododendron*

maximum L., *Fraxinus Americana L.*, *F. Pennsylvanica* Marsh., *F. lanceolata* Borck.

Scattering from the coniferous zone :

Gymnospermæ : *Chamæcyparis thyoides* (L.) B. S. P., *Pinus rigida* Mill.

Angiospermæ : *Diospyros Virginiana* L., *Ilex opaca* Ait.

CONIFEROUS (SOUTHERN) ZONE.

Gymnospermæ : *Pinus rigida* Mill., *P. echinata* Mill., *P. Virginiana* Mill., *Chamæcyparis thyoides* (L.) B. S. P.

Angiospermæ : *Quercus Phellos* L., *Q. nigra* L., *Q. minor* (Marsh.) Sarg., *Q. alba* L., *Q. coccinea* Wang., *Q. velutina* Wang., *Magnolia Virginiana* L., *Cratægus uniflora* Münch., *Prunus maritima* Wang., *Ilex opaca* Ait., *Diospyros Virginiana* L.

Scattering from the deciduous zone :

Gymnospermæ : *Pinus Strobus* L., *Tsuga Canadensis* (L.) Carr.

Angiospermæ : *Castanea dentata* (Marsh.) Sudw., *Hicoria alba* (L.) Britton, *Liriodendron tulipifera* L.

SPECIES MORE OR LESS ABUNDANT IN BOTH ZONES.

Populus tremuloides Michx., *Salix nigra* Marsh., *Betula nigra* L., *B. populifolia* Marsh., *Alnus rugosa* (Ehrh.) Koch., *Quercus ilicifolia* Wang., *Sassafras sassafras* (L.) Karst., *Liquidambar styraciflua* L., *Prunus serotina* Ehrh., *Acer rubrum* L., *Nyssa aquatica* L.

It may be noted that three species (*Q. alba, Q. coccinea,* and *Q. velutina*) are listed as characteristic trees in both zones. This means that they are so abundant in both that any description of the prevailing vegetation in either would be incomplete unless they were mentioned.

On the other hand, the species listed as abundant in both zones are equally wide in their distribution with the three species just mentioned, but none of them is so abundant as to be characteristic, being more or less scattered and usually following minor surface features, such as water courses, swamps, roadsides, etc.

If a complete enumeration of the trees which inhabit each zone be studied, it may be readily seen that the deciduous zone contains the greatest number and diversity of genera and species, and that they are, as a rule, well mixed; no one species forming the bulk of the forest over any considerable area. In the coniferous zone, on the contrary, the monotonous uniformity

of the forests, due to extensive aggregations of a few predominant species, is conspicuous over hundreds of square miles. *Pinus rigida*, for example, is not only the predominant, but almost the exclusive species over extensive areas, but no such example can be quoted in regard to any one species in the deciduous zone. If the geology and topography of the zones be considered, it may be seen that the deciduous is exceedingly varied in each of these features. The geological formations represented are numerous; the soil in consequence varies greatly, while the surface presents every gradation between low level plains and hills of considerable altitude. Its southern line is quite sharply coterminous with the southern edge of the Triassic formation, while in all other directions it extends up to and beyond the state lines. On the other hand, the coniferous zone presents but little diversity in either geology or topography. The geological formations represented are few. The soil has an almost uniform character throughout, and the surface irregularities are relatively small. Its northern border is coterminous with the northern border of the Tertiary gravels, sands, and sandy clays, and it is limited on its southern and eastern borders by a fringe of modern sand beaches and salt marshes, while southwestward it extends beyond the limits of the state. It is more restricted in area and less capable of expansion, by reason of its geographic position, than is the deciduous zone.

The tension zone includes practically the whole of the Cretaceous plastic clays and the Cretaceous and Tertiary clay-marls and marls. It is intermediate geographically, and in its geologic and topographic features, between the other two.

These facts may be observed to advantage at several critical localities, as, for example, in the vicinity of Farmingdale. At this locality there is an area of marl, like an oasis in a desert, located well within the border of the sands and gravels. If a line be traversed, starting from the vicinity of Lakewood, in the heart of the coniferous zone, little else than *Pinus rigida*, *P. echinata*, *Quercus alba*, *Q. velutina*, etc., are to be seen until the border of the marl area is reached, when the pines disappear and are replaced by deciduous trees, amongst which may be

noted *Quercus rubra, Hicoria alba, Ulmus Americana, Populus tremuloides, Castanea dentata, Liquidambar styraciflua, Betula nigra,* etc.; and these prevail until the marl area is crossed, and the sands and gravels are again encountered, when the conditions are reversed, pines once more become predominant; and this condition prevails until the main marl belt is reached near Eatontown, where deciduous trees again replace the pines. The lines of demarcation in crossing from one geological formation to the other are so sharply defined by the vegetation as to be apparent within a fraction of a mile.

If the same marl area be crossed in a direction at right angles to the previously described route, beginning in the deciduous zone near Monmouth Junction, an equally significant series of facts may be noted. In this vicinity the trees are almost wholly deciduous, consisting largely of *Quercus rubra, Q. alba, Q. velutina, Hicoria alba, H. glabra, H. ovata, Ulmus Americana, Fraxinus Americana, Fagus atropunicea, Castanea dentata, Liriodendron tulipifera, Liquidambar styraciflua, Populus tremuloides, Carpinus Caroliniana, Platanus occidentalis, Acer rubrum, Cornus florida,* etc., with occasional groups or individuals of *Juniperus Virginiana* and *Pinus Strobus,* all of large size or young vigorous growth.

In crossing the clay belt, towards Jamesburg, the first thing which attracts attention is that several of these species become less prominent, or disappear entirely, and that those which continue are noticeably smaller in size and less vigorous in growth. Several new species make their appearance, such as *Quercus ilicifolia, Q. nigra, Pinus Virginiana,* etc.; and these conditions prevail until well within the borders of the marl belt near Englishtown, when the trees again become somewhat larger in size. This variation in the size of the trees was found to be coincident in most cases with the presence or absence of local areas of sand and gravel — the smaller trees occurring in connection with these areas, which areas were also coincident with the distribution of certain species. For example, in one locality, about a mile north of Englishtown, the road passes through quite a deep cut, in a sand hill of considerable extent laterally and vertically. On this hill is quite a growth

of *Pinus rigida* and *Diospyros Virginiana*, although both species are conspicuous by their absence elsewhere in the vicinity.

In the neighborhood of Freehold some of the species which were sparsely represented before become more prominent, and then a marked change occurs as soon as the border of the main marl belt is passed. In place of the almost exclusively deciduous vegetation, patches of *Pinus rigida* become prominent; and these continue until the marl area at Farmingdale is reached, when the pines disappear and are not again met with until the area is crossed. By this route it may be seen that the entire width of the tension zone is crossed where the relations of the two floras are the most complicated.

Another interesting locality is the vicinity of Perth Amboy, where the terminal moraine extends beyond the Triassic border and encroaches for a short distance on the Cretaceous. Here the typical deciduous flora, which elsewhere is coterminous with the border of the Triassic, is in existence beyond, following the edge of the moraine, where it is in sharp contrast with the tension zone representatives of the coniferous flora, which here reach their most northern limit in the state.

At many other localities the same or similar facts may be noted, but the above instances are probably sufficient to illustrate the general facts of distribution.

In order to illustrate some facts of specific distribution, the following examples are taken :

Tsuga Canadensis. — More or less abundant in the deciduous zone, especially in hilly and rocky regions along the borders of streams. Not recorded south of the tension zone, except indefinitely as very rare, in Ocean and Monmouth Counties. The only exact localities known to me south of the Triassic border are New Egypt, Vincenttown, and Burlington, all within the tension zone.

Rhododendron maximum. — Abundant in the deciduous zone, often forming dense thickets along streams and lake borders. Recorded from but one locality south of the tension zone, at Sicklerville, and from two within the zone, at Burlington and Kinkora.

Pinus Virginiana. — More or less abundant in the coniferous zone, often forming small forests. Locally quite frequent in the tension zone, especially on the clay belt, but only recorded from within the deciduous zone, at widely separated localities — New Brunswick, Milford, and Riegelsville.

Pinus echinata. — Most abundant in the tension zone, often forming groves of considerable extent. Less abundant in the coniferous zone and not recorded from the deciduous zone.

Chamæcyparis thyoides. — Forms the bulk of the vegetation in the cedar swamps of the coniferous zone. Rare in the tension zone. Locally abundant in certain swamps in the deciduous zone.

Ilex opaca. — Common in wet woods in the coniferous zone. Less abundant in the tension zone. Reported from but one locality in the deciduous zone, at Carpentersville.

Quercus Phellos. — More or less abundant in the southern part of the state, especially in the tension zone, where it occurs close to the Triassic border, but has not been recorded from the deciduous zone.

Quercus nigra. — Practically the same range as the last.

That the distribution of these species is not wholly due to climatic conditions is evident. In the case of *Chamæcyparis* we have a species which occurs as far north as Massachusetts, and as far south as Florida, its occurrence being determined by physiographic conditions.

In considering others of the species we may even eliminate these conditions. *Quercus Phellos* and *Q. nigra*, for example, extend northward in the eastern part of the state as far as Perth Amboy, while in the western part they are not known north of Trenton. A line drawn between these two places defines the northern limit of distribution for these species. The topographic features in the immediate vicinity on both sides of this imaginary line are the same, and yet they do not cross it. The fact which is at once apparent, however, is that this line is coincident with the line of demarcation between the Triassic and Cretaceous formations, and the rational inference is that this feature is the important one to be studied. These two species are taken as special examples in this connection,

because their limits of distribution are so sharply defined; but careful tabulation of similar facts in regard to others would prove equally interesting and significant.

If the foregoing facts be carefully considered, one feature is sure to attract attention by reason of its constant reiteration. This is the influence apparently exerted by the geologic formations upon the distribution of certain classes and species of trees, or, for the sake of argument, the coincidence which exists between certain geologic formations and certain facts of plant distribution.

From whatever point of view we may regard the matter, it finally resolves itself into an examination of the soil conditions, which are directly dependent upon the structure and composition of the geologic formations from which the soils were derived. Soil influence is indicated in all the facts of plant distribution throughout the state as one of the most potent factors, and in some instances as the only one, to be taken into consideration; and here it seems pertinent to remark that the name which any geologic formation may bear is of no consequence in this connection, except for purposes of identification. The only matter of any moment is its lithological characters, either mechanical or chemical, irrespective of age or stratigraphic position. A sandy soil, whether a recent dune deposit or one formed from the disintegration of Paleozoic sandstone in place, would be of equal importance so far as sand-loving plants are concerned. In the same way a heavy soil, whether of cretaceous marl or glacial till, might be equally available as a home for species which must have such a mechanical condition for their proper growth. Those which merely require a rocky soil would also be indifferent as to whether the rock was Eozoic granite or Triassic trap.

This line of argument, therefore, infers that the mechanical structure of the soil is of equal importance with its chemical constitution; and this is apparently the fact. The observations made seem to indicate that the former is the more powerful in influencing the original location and distribution of species, while the latter more largely affects their subsequent growth.

Upon this basis of reasoning we may account for the fact that

species from the deciduous zone, where the soils are comparatively heavy, are able to push their way southward into the marl of the tension zone, and we may also note the effect of the chemical composition of the soil on the growth of these species, as indicated by their decreased size wherever they occur on areas of sand or gravel. In similar manner we can understand the reason for the northward extension of *Pinus Virginiana* at Perth Amboy, on account of the sandy or gravelly surface soil, and its abrupt limitation in that locality, at the terminal moraine, the soil of which is more compact and heavy. *Quercus Phellos* and *Q. nigra* are, without doubt, limited in their distribution by the same causes, and we are justified in assuming that if the soil conditions which favor them, or, what is the equivalent, the geological formation on which they grow, had a further northward extension, the species mentioned would be found upon it irrespective of climatic conditions.[1]

One thing, however, which should not be ignored in regard to characteristic species of any zone is that they do not always exist where they are found by reason of the environment being the most favorable one for them, but because the environment may be unfavorable for other species. For example, *Pinus rigida*, as previously noted, exists in parts of the sand barrens of Burlington, Ocean and Atlantic Counties, almost to the exclusion of all other trees; but it is stunted and conspicuously less vigorous in appearance as a whole than where it occurs as scattering groves or individuals further north in richer soil. The natural inference is that it would exist to better advantage in a different soil from that in which it is most abundant, but that other more aggressive species are able to occupy and hold such soils against it, and that in the sand barrens it merely exists by reason of freedom from competition. This inference is further strengthened if we consider its wide geographic range, which extends from New Brunswick to Georgia and

[1] The following references may be found of interest in this connection:

1. Britton, N. L. On the Existence of a Peculiar Flora on the Kittatinny Mountains of Northwestern New Jersey, *Bull. Torrey Bot. Club*, vol. xi (1884), p. 126.

2. Hollick, Arthur. Plant Distribution as a Factor in the Interpretation of Geological Phenomena, etc., *Trans. N. Y. Acad. Sci.*, vol. xii (1893), p. 189.

includes a great diversity of soil and climate. It is doubtful whether the sand barrens in many localities could ever be reforested by deciduous trees after the complete destruction of the pines. Certainly many such areas have remained completely devoid of any growth for many years, whereas in the deciduous zone clearings quickly become reforested, often by pines and cedars which were not before to be found in the region.

When the soil characters of each zone are studied, it becomes easy to understand why the character of the vegetation in each is so different. In the deciduous zone the rocks are partially weathered and disintegrated for a considerable depth, and this disintegration is unceasingly going on, constantly adding new material to the soil from the variety of the mineral constituents in the rocks. New soil is constantly being made and the old soil being renovated, so that plant food is in process of manufacture all the time. The character is also such that it is capable of retaining moisture for a considerable period, which is a valuable factor in periods of drought.

On the other hand, in the coniferous zone the rock has long been almost completely disintegrated, and as it is practically composed of but one constituent, quartz, which is of little or no value for plant food, any further disintegration is incapable of yielding any other element, and but little is added to the soil which could serve to support vegetation. Further than this, in many places no rock disintegration is going on, but, on the contrary, rock is in actual process of formation. Sandstones and conglomerates are being formed by cementation with limonite, and where this occurs, a hard layer results which limits the downward growth of roots, while if the conditions are such that an open porous sandy soil prevails, it becomes impossible for water to be retained in it, and an arid sand barren is the result.

The logical conclusion is that if the flora of the coniferous zone should be destroyed, its reëstablishment in the zone would be a very difficult matter on account of the hostile physical conditions which are ceaselessly at work there; while in the deciduous zone its struggle for existence, even if it gained a

foothold there, could not be maintained against the more aggressive deciduous flora. That these adverse conditions, physical and biological, have long been active in modifying the character of the coniferous flora, and circumscribing its limits, we know from the geological records, and that they may be expected to continue in the future we have every reason to believe. In other words, we have to regard the coniferous flora, taken as a whole, as representing a waning type of vegetation, which reached its maximum of development in past geologic time, and which has since then been slowly but inevitably giving way to the deciduous type, which is now in the ascendant.

The relation between the historical development or evolution of the living floras and the facts of their present distribution will be discussed in a subsequent paper.

GEORGE BAUR'S LIFE AND WRITINGS.

WILLIAM MORTON WHEELER.

GEORG HERMANN CARL LUDWIG BAUR was born in Weisswasser, Bohemia, Jan. 4, 1859, into a family noted for its learning. His father and three of his father's brothers were professors in German universities. Among the latter was the theologian Gustav Baur, professor at Leipzig. George Baur's father, Franz v. Baur, was professor of forestry and director of the "Forstwissenschaftliche Versuchsanstalt" at Munich from 1878 to 1897, and rector of the university from 1895 to 1896.

GEORGE BAUR.

The year after George Baur's birth Franz Baur, who had been chief forester ("Oberförster") of Weisswasser, left Bohemia and after a short stay in Giessen occupied a lonely "Forsthaus" between Frankfurt and Darmstadt. George Baur's earliest memories went back to this secluded dwelling in the forest of which his father was superintending forester. Here, too, the family did not tarry. In 1864 Prof. Franz Baur accepted the chair of forestry in the Academy of Hohenheim, near Stuttgart. Here he remained till he was called to Munich in 1878. It was in Hohenheim that George Baur passed the happiest years of his childhood. He was sent to school in the spring of 1865. According to his own statement, he learned with difficulty.

Memorizing, especially, was irksome to him, and in later years he often complained of the absurd pedagogical methods in vogue during his boyhood. Such time as he could spare from his lessons he passed in the woods about Hohenheim, and he has left a charming little description of himself and playmates acting Fenimore Cooper's *Mohicans*, chasing one another through the woods with bows and tomahawks. There was only a "Lateinschule" in Hohenheim, so George Baur's parents decided to send him to a "Realgymnasium" at Stuttgart. He accordingly left Hohenheim and entered on his further studies during Easter, 1873. The "Realgymnasium" had an excellent director, Dr. Dillmann, a man of whom Dr. Baur always spoke with gratitude and affection. The final examinations in the Stuttgart "Gymnasium" appear to have been very severe, for Dr. Baur has often told me that the horror of these examinations kept recurring to him in his dreams years after he had grown to manhood. These dreadful examinations, however, were successfully passed, and he left the last class of the "Gymnasium" during the autumn of 1877. During the year following he returned to Hohenheim and entered the academy with the intention of becoming a forester like his father. He became Professor Niess's assistant in geology and paleontology and soon decided to change his plans and make these subjects his life's work. In the fall of 1878 he entered the University of Munich. There he studied chemistry with Bäyer, zoology with v. Siebold, and botany with Nägeli, till he had completed the summer semester of 1880. Thereupon he went to Leipzig, and during the winter of 1880–81 and the following summer semester studied comparative anatomy with Leuckart, geology with Credner, and phylogenetics with Carus. During the autumn of 1881 he again returned to Munich to complete his university work. He studied paleontology with v. Zittel, physiology with Voit, and histology and embryology with v. Kupffer. He defended his inaugural dissertation, entitled "The Tarsus of Birds and Dinosauria, a morphological study," July 18, 1882. The *quaestio inauguralis* referred to Gegenbaur's archipterygium theory. Baur had now fully decided to follow a university career, and as the first step in this direction he became assistant in his-

tology to Professor v. Kupffer in the "Anatomisches Institut" of his alma mater. In March, 1884, he was called to New Haven to act as Professor Marsh's assistant. During the same year he married Fräulein Auguste Wachter of Munich. Dr. Baur served Professor Marsh till Feb. 1, 1890, when, owing to certain difficulties with that gentleman, he resigned his position and left Yale University. During the summer of 1890 he collected fossil reptiles and fishes in western Kansas for Professor v. Zittel. In the autumn he accepted the position of docent of comparative osteology and paleontology at Clark University, Worcester, Mass. The calm atmosphere of investigation pervading that institution allayed the excitement into which he had worked himself on leaving Yale, and having entered on a position where free and independent investigation and publication were not merely tolerated but required, he began to plan several extensive works. One of these was an elaborate monograph of the North American tortoises, to be published by the National Museum as a companion volume to Cope's *Batrachia*. Another was the investigation of the faunas and floras of oceanic islands. During the two years that Dr. Baur held his position at Clark he made great progress in both of these undertakings. In 1891, through the kindness of Mr. Salisbury of Worcester, Professor H. F. Osborn, and others interested in Clark University, he was enabled to fit out an expedition to the Galapagos Islands. Accompanied by Mr. C. F. Adams, he left in May and returned in October, after visiting nearly all the islands of the archipelago. The study of his extensive collections of the plants and animals of these islands has since occupied Dr. Baur and several zoologists and botanists both in this country and in Europe. The various reports, embodying descriptions of many new species, had been nearly all published, and just before his last illness Dr. Baur was planning a general work on the Galapagos Islands to include all the results of the expedition, together with an elaborate introductory chapter by himself. The valuable collections were recently purchased by the Tring Museum, which is undertaking a further study of the Galapagos fauna.

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In 1892 Dr. Baur was called to the University of Chicago as assistant professor of comparative osteology and paleontology, and three years later was advanced to an associate professorship in the same institution. Here he bent all his energies to developing the department of which he had charge. For the purpose of increasing the paleontological collections of the university two expeditions were sent out, one to eastern Wyoming, in charge of Dr. Baur himself, and a few years later another to Texas, in charge of Dr. E. C. Case. Besides the work on the material collected on these expeditions, his turtle monograph, and the Galapagos material, Dr. Baur spent much time in working out elaborate courses of lectures on vertebrate osteology and phylogenetics. His classes were never large, owing partly to the advanced and highly specialized nature of the subjects presented and partly to his inability to express himself in a clear and attractive manner in the English language. Incessant work along so many different lines wore on his highly nervous organization. During September, 1897, his friends feared that his mental health was giving way, and he was persuaded to go abroad, in the hope that a year's sojourn with his relatives in Munich and southern Tyrol might restore him to health. His illness (general paresis) was not dispelled by the change. It was found necessary to transfer him to an asylum, where he soon succumbed, June 25, 1898. He was buried at Munich. Prof. v. Kupffer, who helped to equip the young scientist for his brief but brilliant career, placed the merited laurel wreath upon the grave. Very near Dr. Baur reposes George Ebers, who died a month later.

Such was Dr. Baur's external and uneventful life; his true inner life was one of constant and enthusiastic investigation, which is but imperfectly indicated in the list of his published works appended to this article. The hundred and forty odd papers bequeathed to science are only a prodromus of the greater things which he hoped to accomplish in the near future. Like Professor Cope, whom he greatly admired and whose successor in herpetology he had hopes of becoming, he possessed a very active mind and wide interests. That he was always busy with a number of problems simultaneously is shown by a perusal of

the list of his writings. None of his works are of considerable length, many of them are mere notices, but prolixity is not one of their faults. He often condensed much patient research, both in the laboratory and the library, into an astonishingly small space. He cannot always be excused from the fault of publishing too hastily and having subsequently to change his opinions. Nor did he always succeed in maintaining his ground against his opponents without undue emphasis and unpleasantness of expression. This unpleasantness of expression was unintentional, however; being due to a certain abruptness in the use of the English language. Most of his papers appeared in a comparatively small number of journals, many of them in the *American Naturalist* and the *Zoologischer Anzeiger*.

Dr. Baur's inaugural dissertation on the tarsus of birds and Dinosaurs is the keynote to much of his later work. It begins with a study of the developing limb skeleton of the bird and branches out into a comparative study of the limbs of the extinct Dinosaurs. The closing paragraph of the paper seems to contain the germ of his later views on the origin of variation, views which were practically identical with those of the Neo-Lamarckian school. In this paragraph he maintains that the appendages of oviparous animals are more variable than those of ovo-viviparous and viviparous forms, "as a viviparous animal which develops in the uterus, far from disturbing external influences, especially those of a mechanical nature, when born exhibits a tolerably truthful picture of its ancestors, since what it possesses at birth is inherited. An oviparous animal, on the other hand, will present a much less truthful picture of its ancestry," etc. Dr. Baur would probably have dissented from this crude view in after years, but he never altogether abandoned the assumption that variations in living organisms are traceable to the inherited effects of the environment.

Dr. Baur made the Reptilia the center of his researches in paleontology and osteology. His thorough and extensive knowledge of the diversified structure of living and fossil reptiles enabled him to arrive at very correct conclusions respecting mooted questions in the osteology of the fishes on the one hand, and the birds and mammals on the other. Dr. O. P. Hay, who

studied with Dr. Baur, has published in *Science* (July, 1898, pp. 69 and 70) a brief but excellent account of Dr. Baur's work in herpetology :

"Dr. Baur's especial interest was in the morphology of the vertebrate skeleton. Although he recognized the great value of descriptive osteology, such work alone did not satisfy the demands of his mind. Although he wrote much on vertebrate paleontology, he was the describer of few new genera and species. His constant effort was to discover the relationships of forms and the way in which they had originated. He was thus impelled to study the homologies of the various bones and to attempt to connect them with the skeletons of more primitive forms. In many of his papers we find attempts made to unravel the genealogy of groups and to base classifications on this genealogy. His views regarding the scope and the methods of comparative osteology may be learned from a lecture published in *Science*, 1890, vol. xiv, p. 281." * * * "In studying the development of the limbs, Dr. Baur held that the Amniota which possessed more than five fingers were highly specialized forms and not primitive ones, presenting transitions from the fishes. His view is now probably very generally accepted.

"A number of his papers related to the structure and the systematic position of the leather-back turtle Dermochelys. He opposed strongly the views of Cope, Dollo, Boulenger, and Lydekker, that this reptile forms a suborder distinct from all other living tortoises. He regarded it as belonging to merely a highly specialized branch of the Pinnata, a group which contains our living sea turtles.

"The structure and relationships of the Mosasauridæ form the subject of several interesting papers. In opposition to Professor Cope, who maintained that these extinct reptiles bore special relationship to the snakes, Dr. Baur held that they were true lizards, closely related to the Varanidæ, but modified for adaptation to an aquatic existence. An excellent paper on the structure of the skull of the Mosasauridæ was published in the *Journal of Morphology* for 1892.

"As early as 1886 Dr. Baur wrote a paper on the homologies of the bones of the otic and temporal regions. His interest in

the subject never relaxed, and some of his latest papers were written in a discussion of the subject with Professor Cope.

"In the same year above mentioned, 1886, Dr. Baur became interested in the morphology of the vertebral column, and he published a paper of considerable length in the *Biologisches Centralblatt* of that year, stating his conclusions. He gave his adherence to the opinion of Cope, who held that the vertebral centrum in all the Amniota has developed from the pleurocentrum, an element which is found distinct in the Stegocephali. He found confirmation of his views in the vertebral axis of the Pelycosaurian reptiles, in Sphenodon, certain lizards, birds, and even mammals. He advocated the same views in one of his latest papers.

"In the *American Naturalist* for May, 1891, occurs an important paper by Dr. Baur on the reptiles known as the Dinosauria. In a characteristic manner he gives the history and the literature of the subject and his own conclusions. His opinion was that 'the Dinosauria do not exist.' He believed that this group is an unnatural one, and is made up of three special groups of archosaurian reptiles which have no close relation to one another.

"Two of Dr. Baur's most important later efforts are probably one entitled 'The Stegocephali,' a phylogenetic study published in the *Anatomischer Anzeiger* for March, 1896, and one, a joint paper with Dr. E. C. Case, having the title 'On the Morphology of the Skull of the Pelycosauria and the Origin of the Mammalia,' and appearing in the *Anatomischer Anzeiger*, 1897, pp. 109–20. In the first-mentioned paper Dr. Baur compares the skeletal structure of the Stegocephali with that of various fishes, and comes to the conclusion that the Batrachia took their origin from the Crossopterygia, rather than from the Dipnoi. The second paper was based on the fine materials collected by Dr. Case in the Permian formation in Texas. The authors concluded, on the one hand, that the Pelycosauria are closely related to the Rhynchocephalia, and that, on the other hand, they could not have been the ancestors of mammals. The authors were inclined to regard the Gomphodontia as the ancestors of the mammals."

Dr. Baur's interest in the more general problems of morphology, such as the origin of variations, was first keenly aroused at Clark University at a time when Weismann's essays were the subjects of much general discussion. He always remained a steadfast Neo-Lamarckian, never forsaking the position he had taken in his inaugural dissertation. A perusal of Wagner's and Eimer's works convinced him that isolation and environment are potent factors in producing variation. A previous study of the giant land tortoises of the Galapagos, in connection with his turtle monograph, and further studies on a genus of lizards (Tropidurus) which has produced different so-called species on the various islands of the archipelago, led him to conclusions which his subsequent visit to the islands did not modify. It was, perhaps, fitting that one born in the year of the publication of the *Origin of Species* should gain inspiration from the spot where the idea of the "Origin" was conceived. At the very outset, however, he announced a far-reaching opinion utterly at variance with Darwin's view of the origin of the Galapagos. The great English scientist believed that the Galapagos were oceanic islands that had never been connected with the mainland — a view which Alex. Agassiz has supported after renewed study of the region. Dr. Baur rejected the hypothesis of the consistency of continents and oceans and asserted that the Galapagos, like the Antilles, were formed by subsidence and not by upheaval, and that they were at one time connected with Central America through Cocos Island. This contention Dr. Baur attempted to prove by showing that each separate island has its own peculiar and harmonious fauna and flora — a condition which could hardly exist if the archipelago were of volcanic origin and had acquired its plants and animals through accidental importation by means of currents from the mainland. Dr. Baur insisted on the harmonious distribution over the various Galapagos Islands of such organisms as the giant land tortoises, the lizards of the genus Tropidurus, the species of Nesomimus and other passerine birds, and the plant known as *Euphorbia viminea*. Since there was no evidence of intermigrations between the various islands to disturb the pronounced individual character of their faunas and floras, how

could one suppose that the islands had been originally peopled from the mainland six hundred miles away? Surely, he contended, isolation of faunas and floras, produced by the gradual subsidence of a mountainous area and its conversion into islands, would be a far simpler and more adequate explanation of the facts than the Darwinian theory of upheaval. Dr. Baur's view met with derision in some quarters, but recently investigators of repute, like Günther, Ratzel, Böttger, Ortmann, and Hemsley, have cast their vote in his favor against Darwin, Wallace, A. Agassiz, Stearns, Dall, and Wolf. Ridgway, who has studied the birds, and Robinson and Greenman, who have studied the Galapagos plants collected by Dr. Baur, have taken a safe neutral ground and await further evidence before expressing an opinion.

Encouraged by the recognition of the subsidence theory, Dr. Baur began to test the faunas and floras of other islands in the Pacific in the same manner as he had tested those of the Galapagos. In his last paper in the *American Naturalist* he took up the distribution of various groups of animals (crustaceans, ants, frogs, lizards, and birds) on the Solomon and Fiji Islands, and in New Caledonia, in an endeavor to show that these islands, too, were of continental origin, contrary to prevailing opinion. He did not live to complete this paper, his last effort to break the bonds of authority and open to renewed discussion the question of the origin of island faunas and floras. The man to continue this work worthily has not yet risen among us.

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ON THE SPECIFIC GRAVITY OF SPIROSTOMUM, PARAMÆCIUM, AND THE TADPOLE IN RELATION TO THE PROBLEM OF GEOTAXIS.[1]

JULIA B. PLATT.

It is known that some algæ and Infusoria tend to collect near the surface of the water in which they live. A number of experiments have been made which seem to demonstrate that the tendency thus manifest cannot be ascribed altogether to the attraction of light, or to the source of oxygen supply, since these algæ and Infusoria still move upwards when the experimental conditions are such as destroy or reverse the normal relations to air and light. It is, therefore, affirmed that these organisms react to the force of gravity. This reaction, or negative geotaxis, is attributed by Schwarz ('84) to the direct influence of gravity on the organism, which incites motion in the opposed direction, while Jensen ('93) attributes the reaction to the indirect influence of gravity on the organism by means of the difference in hydrostatic pressure at different depths. The experiments of these authors seem to show that the possibly excentric position of the center of gravity in the organism cannot be regarded as a factor determining the direction of motion.

Dr. C. B. Davenport suggested that a simple and hitherto unrecorded method of approaching the problem of geotaxis might be by means of solutions of varying density in which the infusorian would still live. Obviously, if the conclusion of Schwarz ('84) were right, the negatively geotactic organism should become positively geotactic in solutions of greater specific gravity than its own, supposing the animal to be normally heavier than water.

[1] This short study was undertaken as laboratory work in connection with Dr. C. B. Davenport's course in *Experimental Morphology*. My cordial thanks are due Dr. Davenport for the kind interest with which he followed the work.

Unfortunately, for the success of the experiment, I have been unable to obtain in Cambridge, Paramæcia which showed decided geotactic reaction. My results may, nevertheless, serve as a basis for further experiment by those more fortunate in the material at their command.

The Method.

The specific gravity of the organism was to be obtained by finding the density of a solution in which the animal, either dead or paralyzed, remained suspended without rising or falling. This known, the movements of the living infusorian in solutions of the same, of greater, and of less specific gravity were to be recorded. It was, therefore, necessary to find a substance in solutions of which Infusoria will live, and a reagent that will kill or paralyze the animal with little apparent change of form.

I found that in solutions of salt, sugar, and glucose, of sufficient density to be serviceable, Infusoria do not live, but in dying increase their specific gravity, probably owing in great part to loss of water. Gelatine was not satisfactory, since even weak solutions tend to become stiff when cold. After failing with the above-mentioned substances, I found gum arabic admirably adapted to my purpose. Solutions surpassing the specific gravity of protoplasm are easily obtained, and Paramæcia or Spirostoma live for hours in solutions heavier than their specific gravity, not only surviving, but also multiplying, when kept for days or weeks in solutions of less weight.

To exclude the small error that might arise from water contained in the gum, the specific gravity of the solution has not been determined by adding a known weight of the gum to a given volume of water, but in each case the solution has been weighed and compared directly with the weight of the same volume of water.

Spirostomum.

Although Spirostoma frequently lie on the bottom of the vessel in which they are cultivated, they are also often found

suspended in the water with their long axis in a vertical plane, and with the anterior end of the body directed upwards. As it is possible that the maintenance of this position is in reaction to gravity, I tried the effect of placing Spirostoma in solutions denser than water. When Spirostomum moves, it usually advances first the smaller end of its elongated body, or the end which is opposite the large contractile vacuole; and this I consequently call the anterior end of the body. Spirostomum occasionally reverses its cilia and moves backwards, but the regression is of momentary duration, and the small organism returns directly to its usual manner of motion.

A fortunate accident by which a faint trace of some unknown poison must have been present in the culture jar to which a number of Spirostoma were transferred, rendered these Infusoria motionless without killing them. When examined under the microscope it was found that their cilia did not move, yet an occasional spasmodic contraction demonstrated that life still continued. I was thus enabled to obtain the weight of *living* Infusoria, and the result was subsequently confirmed by similar experiments with Spirostoma that were not poisoned, but merely exhausted by long cultivation in the laboratory.

To avoid currents that would arise from introducing water with the Spirostoma into the gum arabic solution, they were first drawn from the culture jar with a pipette and ejected into a watch glass, which was gently shaken so that the Spirostoma gathered at the bottom. The water that had been taken up with them was then withdrawn, and gum arabic of the same density as the solution to which they were about to be transferred was substituted. In this solution of gum arabic the Spirostoma were again drawn into a pipette and ejected gently into the midst of the solution with which their specific gravity was to be compared.

In determining the specific gravity of these Infusoria, the reaction during the first fifteen or twenty minutes is alone to be trusted, since Spirostoma, and also Paramæcia, whether living or dead, increase their specific gravity on remaining long in a solution of greater density than water. The paralyzed,

but still living Spirostoma were placed in solutions of differing densities with the following result:

In H_2O, every Spirostomum immediately fell to the bottom.

In gum arabic solutions of sp. grav. 1.0110, all of the Spirostoma fell to the bottom within fifteen minutes, except two or three that were still falling.

sp. grav. 1.0165, the Spirostoma were carried by the slight currents. For the first five minutes indifferently. They then slowly rose, but not to the surface, then fell, but not to the bottom. They were evidently nearly balanced.

" " 1.0165, the above experiment was repeated, and the Spirostoma remained scattered for twenty to thirty minutes. Then all drifted upwards except six which lay on the bottom.

" " 1.0180, Spirostoma remain still for a long time.

" " 1.0190, Spirostoma remain still for a short time, and then rise, *several coming to the surface.*

" " 1.0190, the above experiment was repeated with the same result.

" " 1.0208, Spirostoma slowly rise.

" " 1.0230, after ten minutes thirteen Spirostoma were floating on the surface, and but two still remained in the solution. Both of these were rising. When the solution was shaken, all were scattered, and then rose to the surface again. After two hours all fell to the bottom.

From these experiments it appears that the specific gravity of Spirostomum lies between 1.0165 and 1.0180, or very near to 1.017.

Jensen ('93) also attempted to obtain the specific gravity of an infusorian, Paramæcium, by finding the density of a solution in which the infusorian would neither rise nor fall. He chose for the experiment, however, potassium carbonate, which immediately kills the organism. By means of solutions of potassium carbonate, Jensen decided that the specific gravity of Paramæcium was 1.25. Since his conclusions differ so greatly from the results obtained with gum arabic and living Spirostoma, I repeated the experiment by placing Spirostoma in a solution of potassium carbonate of 1.25 specific gravity, and found that this infusorian rose at once to the surface, and then fell directly back into the solution, where it remained in fact suspended. Evidently potassium carbonate of this density rapidly reduces the protoplasm of the organism to its own weight. Only the

extent of the change (from 1.017 to 1.25) was surprising, for I had already found that Spirostomum changed its weight slightly when living in a medium denser than water, and had also found that, when killed with any one of several reagents, the specific gravity of Spirostomum increases. For example, when Spirostomum is killed with quinine, it sinks in solutions of gum arabic of 1.028 specific gravity, although the living but motionless Spirostomum quickly rises to the surface in a solution of this density.

On placing Spirostomum in a solution of gum arabic slightly denser than its own protoplasm, I found that the infusorian did not remain still in a vertical position, as is its habit in water, but wandered restlessly about. Of those individuals which at the time of observation occupied a vertical, or nearly vertical position, the number with the anterior extremity directed upwards was 48. The number of those with the anterior extremity directed downwards was 81. The larger number of individuals having their anterior extremity directed downwards suggests a tendency to reverse the normal position maintained in water, where the anterior extremity is directed upwards. I doubt, however, if the difference in the numbers should be thus interpreted; for if Spirostomum merely wandered back and forth between the upper and lower surfaces of the liquid, it would rise in a dense solution more rapidly than it would descend. There would thus be at any moment more individuals going downwards than upwards. The power of nice adjustment between the force of the cilia and the force of gravity, which maintains Spirostomum suspended in water, was lost in those individuals which I observed when placed in solutions of greater specific gravity than their own. My conclusions regarding their reaction to gravity are, therefore, purely negative.

Paramæcium.

To obtain the specific gravity of Paramæcia, I tried to paralyze them with ether, quinine, and nicotine, but invariably killed the Paramæcia, which in dying went to pieces. I therefore added a few drops of 0.5 per cent acetic acid to the water con-

taining the Infusoria. As acetic acid is said to swell protoplasm, I also killed Paramæcia by the fumes of osmic acid. Both these reagents caused the Paramæcia to change their shape somewhat in dying, by becoming wider and shorter. Their form, however, remained symmetrical in both cases, and seemed neither enlarged nor distorted.

The results obtained by the two methods were similar. When the killed Paramæcia were placed in a gum arabic solution of 1.018 specific gravity, they remained long suspended in the solution. In a solution of 1.024 specific gravity they rose to the surface as rapidly as they fell when placed in water. The reaction in solutions of nearly the same specific gravity as Paramæcium is less certain than with Spirostomum, since the smaller size of Paramæcium makes it more liable to drift up or down with chance currents, and less rapid in its response to gravity. There is, however, no doubt that the specific gravity of Paramæcium thus killed differs but little from that of living Spirostomum, and differs very greatly from the specific gravity assigned this infusorian by Jensen ('93).

The Paramæcia found in the cultures of our laboratory and in the water of the pools about Cambridge did not show geotactic tendencies. If one were placed in clear water, and were drawn into a capillary tube held vertical, it would rise to the upper surface of the water drawn into the tube, and if the tube were now directly reversed, the Paramæcium would rise again; but if the tube were retained in its original vertical position, the Paramæcium wandered back and forth between the upper and lower surfaces of the water. The water of the culture vessels, which contained dead leaves, bacteria, etc., soon swarmed throughout with Paramæcia, which were found in greatest quantities at the surface where a scum of bacteria gathered. If these superficial bacteria were placed in a glass of clear water, they wandered up and down indifferently.

Tadpoles.

Some toad tadpoles that had just left their gelatinous envelope were observed by Dr. Davenport to swim at once to the

surface of the water in which they were kept. He therefore suggested that the negative geotaxis they thus manifested should also be tested in solutions of gum arabic of differing densities.

I found that between the lengths of 9½ mm. and 12 mm., the specific gravity of the tadpoles decreased from 1.044 for the smaller, to 1.017 for the larger. The smaller tadpoles, which showed marked geotactic tendency, were placed in a phial filled to the brim with a solution of gum arabic heavier than the tadpoles, and the phial was then inverted with care that no bubbles of air were admitted. The tadpoles, which could not have been attracted upwards by the light, since light was admitted at all sides through the glass of the phial, immediately swam upwards, as they had done in water. As there was no air between the bottom of the inverted bottle and the upper surface of the solution, it was equally improbable that the tadpoles were attracted upwards by the air.

When placed in solutions of the same specific gravity as themselves, it was found that the tadpoles still swam to the upper surface of the solution, which as before was in immediate contact with the bottom of the inverted phial. From these experiments it appears that the attraction upwards is neither air nor light, and that the direct action of gravity as expressed in the weight of this organism does not act as the incentive to negative geotaxis. It is possible that gravity may act, however, on some internal organ which is unaffected by the change in the density of the surrounding medium, and may by this means induce the movement upwards. Loeb ('91) has shown that the semicircular canals of the ear in sharks act as balancing organs. Should this also be true for tadpoles, we might find here the explanation of their constant motion upwards, even when the direction of the action of gravity on the organism as a whole has been changed by placing the organism, normally heavier than water, in a medium of greater specific gravity than itself.

It is, moreover, by no means impossible that the action of gravity, which determines the direction in which the Infusoria move, may be through the internal organization of the animal.

In this case the density of the surrounding medium might be expected to effect little, if any, change in the direction in which the organism moves.

Results.

(1) The specific gravity of living Spirostomum lies between 1.016 and 1.018, or is near to 1.017.

(2) The specific gravity of Paramæcium killed by acetic acid, or by the fumes of osmic acid, differs little, if any, from the specific gravity of living Spirostomum, and is about 1.017.

(3) Small tadpoles that are negatively geotactic do not become positively geotactic when placed in solutions heavier than their own specific gravity, as one would expect were their upward motion in direct response to the action of gravity on the organism as a whole. These tadpoles show constant negative geotaxis in water, in a solution of their own specific gravity, and in heavier solutions.

RADCLIFFE COLLEGE, CAMBRIDGE,
June 11, 1896.

LIST OF PAPERS REFERRED TO.

JENSEN, P. '93. Die absolute Kraft einer Flimmerzelle. *Arch. f. d. ges. Physiol.* Vol. liv, pp. 537–551. June 24, 1893.

LOEB, J. '91. Ueber Geotropismus bei Thieren. *Arch. f. d. ges. Physiol.* Vol. xlix, pp. 175–189.

SCHWARZ, F. '84. Der Einfluss der Schwerkraft auf die Bewegungsrichtung von Chlamidomonas und Euglena. *Berichte d. deutschen botan. Ges.* Vol. ii, pp. 51–72.

VERNAL PHENOMENA IN THE ARID REGION.

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IT has recently[1] been laid down by Dr. C. H. Merriam that "the northward distribution of terrestrial animals and plants is governed by the sum of the positive temperatures for the entire season of growth and reproduction," and that "the southward distribution is governed by the mean temperature of a brief period during the hottest part of the year." Dr. Merriam further explains that, "in computing the sum of the positive or effective temperatures, a minimum temperature of 6° C. (43° F.) has been assumed as marking the inception of the period of physiological activity in plants, and of reproductive activity in animals." Let us now consider the facts as observed at Mesilla Park, New Mexico (altitude 3800 feet), and then discuss their bearing on Dr. Merriam's theories. From the meteorological data collected by observers at the Mesilla Park Experiment Station, I have selected the following as illustrative:

	MEAN TEMPERATURE (F.).		MAXIMUM TEMPERATURE.		MINIMUM TEMPERATURE		PRECIPITATION (INCHES).	
	1893.	1896.	1893.	1896.	1893.	1896.	1893.	1896.
January	43.4	41.4	73	71	10	9	.07	.31
February	44.5	41.5	71	75	14	10	1.26	.11
March	50.6	50.5	87	89	21	15	.01	.00
April	58.5	52.3	91	87	29	23	.00	.11
May	62.6	67.0	93	101	33	31	.77	.10
June	77.3	76.8	105	104	46	46	.00	1.01

The following are the latest dates on which the thermometer fell to 30° F. during six years:

1893. 30° on April 29.
1894. 30° " " 2.
1895. 30° " " 3.
1896. 29° on April 20 (23° on April 17).
1897. 29° " " 10.
1898. 29° " " 4.

[1] Life Zones and Crop Zones of the United States, 1898, *National Geographic Magazine*, December, 1894.

The mean temperatures, even in January and February, are high enough to stimulate growth *in those plants which have been introduced from more humid regions*, but *the native vegetation remains backward, notwithstanding the warmth.* The introduced fruit trees at Mesilla Park, many of them, bloom early and have the flowers or fruit annually destroyed by frost. Mr. F. Garcia has kindly given me the following illustrative data:

Kelsey plum	blooms	March 5–11.	Bidswell Late peach	blooms	March 5–7.
Huanhume plum	"	Feb. 19, 20.	Peento peach	"	March 5, 6.
Bungoune apricot	"	Feb. 19, 20.	Foster peach	"	March 16–22.
Moorpark apricot	"	March 8–10.	Elberta peach	"	March 17–22.

The two last-mentioned peaches do not always fail.

There is one native flower which is earlier than any of the above fruit trees, namely, *Sophia halictorum* Ckll. I have found this in bloom as early as January 31, and it is not injured by the subsequent frosts.

This year (1898) Miss Ivah R. Mead made some studies of the life of the tornillo or Pluchea zone at Mesilla Park, which she submitted as a thesis for the degree of B. S. at the New Mexico Agricultural College. The following observations were made by her on a small selected area of the zone in question:

March 12. Everything seemed dead, all that I could find being two tiny plants less than 3 cm. high. These plants were sprouts growing from perennial roots.

March 29. Ten species of plants were found growing; six were too small for identification; the greatest heights of any of the others were:

Pluchea borealis	10 cm.
Gutierrezia sarothræ . . .	15 cm.
Sophia halictorum	9.5 cm. (just beginning to flower).
Sphæralcea lobata	11 cm.

All were perennials or biennials, except the *Sophia*. The cottonwood trees (*Populus fremonti*) were in bud. The mesquite (*Prosopis glandulosa*) and tornillo (*P. pubescens*) showed no signs of life.

April 5. Grass getting quite green. The grass in protected places under the tornillo bushes is doing much better than in the open places.

April 12. Two cottonwood trees in flower. The tornillo bushes still show no sign of life. *Sophia halictorum* is ripening its seeds.

April 23. Tornillo still dormant. *Lycium torreyi* is quite green. A bush of *Atriplex canescens* in full leaf.

April 25. Mesquite bushes show the first tiny green leaves, but tornillo still dormant. *Lycium torreyi* shows the first blossoms.

April 28. One tornillo bush showed signs of life.

By May 11 the mesquite was in full leaf, as also the cottonwood. *Lycium torreyi* was in fruit, but the berries were still green. By May 18 all the tornillo bushes were in full foliage, and the mesquites were flowering.

Miss Mead's notes are considerably more detailed than the above extracts, but it hardly seems necessary to quote them in full. Speaking generally, the facts are these: With one or two exceptions, the native vegetation is backward, notwithstanding the warm weather; *but after the period of the latest killing frosts it comes out with remarkable rapidity*, and a couple of weeks mark the change from barrenness to verdure. At Mesilla Park the domestic honeybee is abroad more or less even in January, but the native bees behave like the native vegetation. That is to say, they do not appear at all until late in March; but then come on very *rapidly*, so as to be very numerous in species and individuals early in April. In 1894 the first bees in this vicinity were taken on March 26, at Little Mountain; but this is above the cultivated area and is warmer than it, the cold air settling in the bottom land. On April 9, however, bees were abundant at the plum blossoms at Mesilla Park, the genera Osmia, Nomada, Synhalonia, Podalirius, Anthidium, Andrena, Prosapis, Halictus, and Agapostemon being represented. At the beginning of May the willows were in flower and attracted various bees.

In 1896 I took two specimens of *Halictus pruinosus* Rob., at Mesilla Park, as early as March 18, and this is my earliest date for a wild bee in that locality. By way of contrast with the above, we may now consider the state of affairs in Washington State. The following meteorological data have been kindly furnished by Mr. G. N. Salisbury, of the Weather Bureau, at the request of Mr. T. Kincaid:

(1) Average temperature (F.):

	Tatoosh Island (Cape Flattery).	Seattle.	Kennewick.
January	41.7	40.6	23.2
February	41.8	41.0	34.2
March	45.8	44.6	51.3
April	47.2	48.5	54.5
May	51.7	55.0	64.3
June	54.3	59.9	70.0

(2) Average precipitation (inches):

	TATOOSH ISLAND.	SEATTLE.	KENNEWICK.
January	12.73	4.80	1.54
February	8.50	3.41	0.42
March	9.14	3.42	0.30
April	7.36	4.01	0.39
May	4.58	2.65	0.50
June	4.04	1.35	0.49

Tatoosh Island has 233 cloudy days in the year, Seattle 159, and Kennewick 58. Of these localities, the first two belong to the excessively humid coast belt; the third is east of the coast range and partakes more of the characters of the arid region. It will be seen at once that the moist region has a comparatively warm winter but a cool summer; the difference between the mean temperatures of January and June being from 13° to 20° F. The inland region, on the other hand, has a colder winter climate, and a considerably hotter summer, with nearly 50° difference between January and June. Comparing the average temperatures at Mesilla Park with these, we find that the first two months nearly agree with those at Seattle, the last four much more nearly with those at Kennewick.

Yet the season at Seattle is ahead of that at Mesilla Park, so far as flowers and wild bees are concerned. Mr. T. Kincaid wrote me from thence on March 13, 1898:

"The willows are now blooming, as well as several other plants, such as *Rubus spectabilis*, *Nuttallia cerasiformis*, *Ribes sanguineum*, etc. Only a few species of bees have appeared so far."

Mr. Kincaid sent me a series of *Andrena perarmata* Ckll., taken at Seattle on March 15 and 16; while Mr. Dunning (*Canad. Entom.*, 1898, p. 269) reports Seattle specimens of this species taken from February 16 to March 14. Many other facts of this kind will doubtless be published by Mr. Kincaid, who is studying the bees of his region.

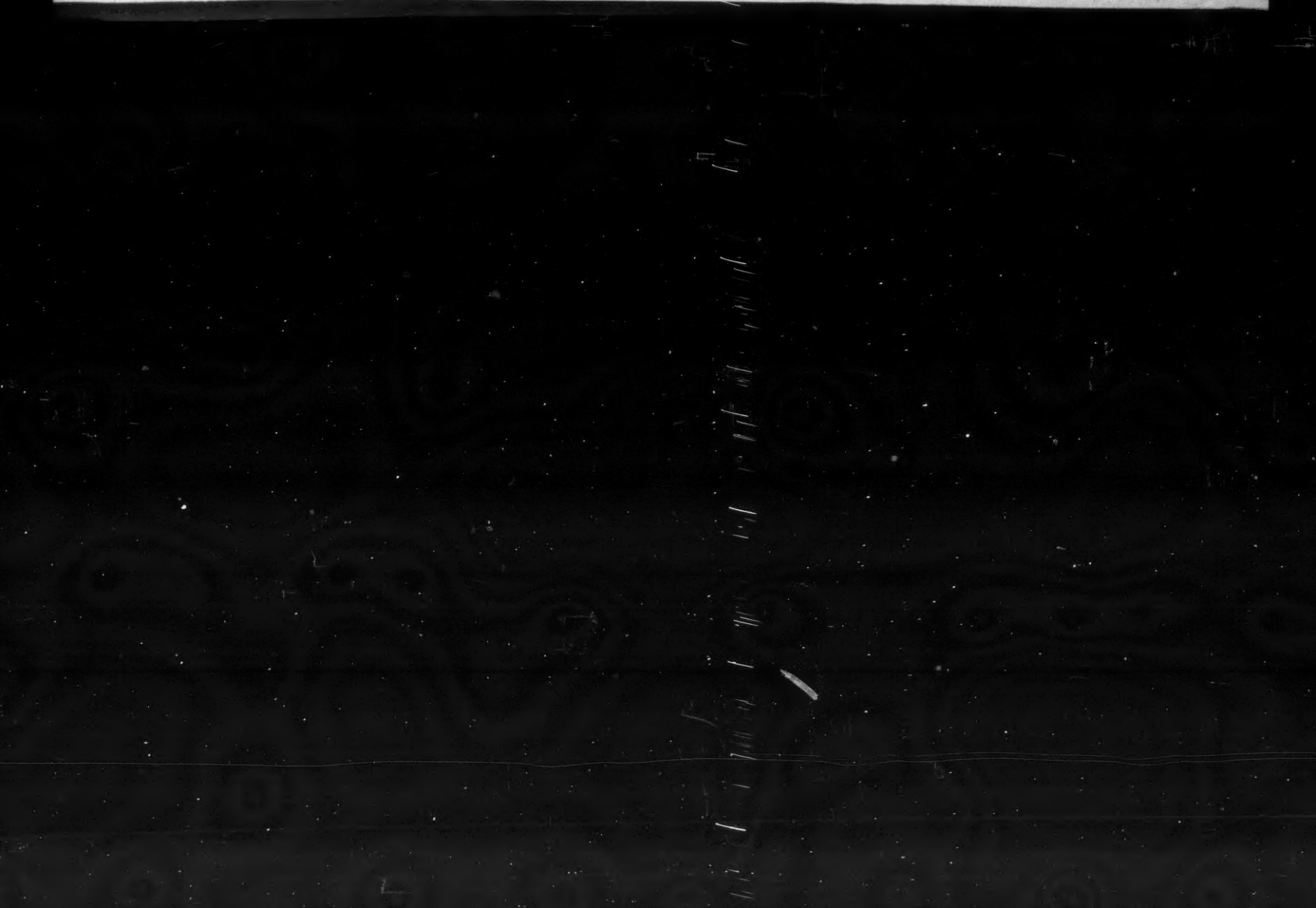
I do not know when the bees first fly at Kennewick, but it is probably later than at Seattle, for the same reasons that affect the Mesilla Valley.

So much for the facts; how do they affect the theory set forth at the beginning?

It appears to me that throughout the arid region, where the sky is clear and the radiation great, *the development of plants and insects is controlled largely by the distribution of frosts throughout the year.* By a process of natural selection the native species (except such as are frost-proof) have learned not to appear or develop until the danger of frost is over. That this tardiness is not due to lack of warmth *per se*, is shown by the fact that introduced plants, such as the fruit trees, rush into bloom and get nipped in consequence. In the cloudy Seattle region it is very different. The climate is more uniform, and there is much less danger of frosts following warm weather. Consequently, both bees and flowers appear early.

The climate of the arid region is thus peculiar and presents a barrier to the ingress of plants and animals from without. For tropical and subtropical species the winters are too cold; for species of moist temperate regions the late frosts following warm spells are usually destructive. It is a curious anomaly that, in a locality having more than tropical summer temperatures, fruits of the temperate zone should fail on account of frost!

Fortunately for the horticulturist, we already know many good late varieties of fruit trees, which escape even the latest frosts at Mesilla Park. But there can be no doubt that the true path to success will be that of selection, and the origination of new and specially adapted varieties; that is to say, man will have to imitate, in as short a while as he can, the process of nature in the case of the native productions. When he has accomplished this, he will reap the full benefit of the many excellent qualities of the climate, the dryness, sunshine and warmth, with moisture under control through a system of irrigation.



A REVIEW AND CRITICISM OF SEITARO GOTO'S[1] WORK ON THE DEVELOPMENT OF ASTERIAS PALLIDA.

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The study of echinoderm development has till recently remained in what may be described as a tantalizing condition. The course of the ontogeny in its main outlines has been known since the days of Johannes Müller, whose work, together with that of Professor Agassiz ('64), may be said to have given us a sketch the details of which had to be filled in. Leaving out of sight the crinoids, which are separated by a deep anatomical gulf from the other echinoderms, we had the researches of Ludwig ('82) on the development of *Asterina gibbosa*, followed by those of Semon on *Synapta digitata* (7), of Bury ('89, '95) on the pelagic larvæ generally, and of Théel ('94) on the development of *Echinocyamus pusillus*, to mention only the most important contributions to our knowledge of the subject. The general disappointing feature about the situation was that whilst there were plenty of half-worked-out problems presented, and suggestive new facts brought to light, there was an absence of any attempt to thoroughly and exhaustively examine the development of any one form, so that instead of certainties we had surmises as to the meaning and fate of larval structures.

This want I endeavored to meet some years ago by a study of the development of *Asterina gibbosa* ('96) from the blastula to the young starfish with ovaries already developed, using the most refined methods, and having at my disposal an immense amount of material. The larva of *Asterina gibbosa* is, however,

[1] Goto, Seitaro. The Metamorphosis of *Asterias pallida*, with special reference to the fate of the body cavities, *Journal of the College of Science*, vol. v. Imperial University, Tokio.

as all know, a modified one, and it was, therefore, my earnest desire that the results obtained by the examination of this form should be tested by a comparison with the development of a normal pelagic larva. And it was, therefore, with considerable pleasure that I awaited the publication of Dr. Goto's researches.

Speaking broadly, a remarkable similarity is disclosed between the two types of development. Some of Goto's figures are almost identical with those which I have already published. I shall first, therefore, sketch the general scope of the paper, and then discuss the principal points of difference between Dr. Goto and myself.

The paper commences with a description of a young bipinnaria, practically quite bilaterally symmetrical, lettered by Goto as stage *B*, the stages considered in the paper being denoted *B, C, D, E, F, G, H.* [I assume, although Dr. Goto does not say so, that the lettering has been chosen to correspond as far as possible with the lettering of the stages of *Asterina gibbosa* given by me; stages *E, F, G,* and *H* appear to be identical in the two cases, and unless this were so, I utterly fail to grasp why Dr. Goto calls the first stage *B*. It is to be desired that this should be explicitly stated, since it is undesirable to introduce an independent lettering with every new species examined.] The changes in external form are then carefully explained; the plane of the developing disk of the starfish is at first parallel to the sagittal plane of the larva; but as development proceeds it is shifted backwards until it occupies the posterior pole of the larva, and is then perpendicular to both the sagittal and frontal planes — so that the direction right to left in the larva is parallel to the disk, as well as the direction dorsal to ventral.

As development proceeds, three "brachiolar" arms are developed on the præoral lobe surrounding a thickened patch of ectoderm, and so the bipinnaria becomes a brachiolaria. Dr. Goto was unable to observe any fixation during the metamorphosis, such as has been seen by Bury ('95) in the case of *Asterias rubens*, and by myself in *Asterina gibbosa* ('96).

As in the case of *Asterina gibbosa*, and contrary to what was believed to take place in the case of bipinnaria, both the larval œsophagus and the larval rectum atrophy; — the præoral lobe

gradually shrinks, and thus the metamorphosis is complete. It is interesting to note that, according to Goto, the permanent œsophagus is fashioned out of the endodermal stump of the larval one.

The fate of the cœlomic cavities next claims Dr. Goto's attention. Originally represented by two completely separated right and left sacs, these spaces have at the period of the first stage studied completely fused in the region of the præoral lobe. The left one is sharply constricted into anterior and posterior portions, and the right undergoes a similar constriction somewhat later. In *Asterina gibbosa*, it will be remembered, there is not only constriction, but also complete separation into two parts in the case of both cavities. The left posterior cœlom assumes a U-shaped form, sending out dorsal and ventral horns. A portion of the right posterior enterocœle is cut off from the rest and forms a closed sac, the "epigastric" cœlom subsequently occupying an aboral position in the young starfish. The remainder of the right posterior cœlom fuses with the left posterior cœlom. The anterior cœlom becomes completely cut off from the posterior cœlomic sacs, and with the diminishing præoral lobe becomes largely obliterated, a portion persisting, however, as the axial sinus. In the septum dividing it from the left posterior cœlom, the stone canal is formed as a groove; this accordingly takes place long after the formation of the pore canal.

Simultaneously with the diminution in size of the anterior cœlom, the watervascular rudiment, present from the first stage as a posterior swelling on the anterior cœlom, becomes completely separated from the axial sinus, the only communication remaining being that *via* the stone canal.

The axial sinus gives off a diverticulum, which forms the dorsal sac of Bury — a structure denominated by me the right hydrocœle. According to Goto, it originates on the left side of the larva.

A peculiar diverticulum of the left posterior cœlom, mistaken by Ludwig ('82) for a rudiment of the "heart," gives rise to a space surrounding the adult œsophagus, and is named by Goto periœsophageal cœlom. It was called by me "oral cœlom."

Lastly, Dr. Goto discusses cavities of "mesenchymatous" origin. Under this heading he includes the peribranchial cavities surrounding the dermal gills, or papulæ, and the radial perihæmal canals, together with the outer perihæmal ring. These spaces, according to him, originate entirely independently of the cœlom by the hollowing out of originally solid masses of mesenchyme cells. The inner perihæmal ring, on the contrary, is an outgrowth of the axial sinus.

Seitaro Goto confirms my statements as to the total want of homology between the aboral poles of the asteroid and crinoid, the origin of the axial sinus and the stone canal, and the persistence of a communication between them, and the origin of the pericœsophageal cœlom and of the inner perihæmal ring. On the other hand, the results of my investigations, which seemed to me the most interesting and important, namely, the primitive segmentation of the cœlom, the existence of a right watervascular rudiment or hydrocœle, the presence of a permanently fixed stage in the ontogeny, and the denial of the existence of any spaces of mesenchymatous origin, are not confirmed by Goto.

It will conduce to brevity and clearness if I state shortly and definitely my position with regard to this discordance in opinion. I am convinced, from the general outline given by Goto, that the development of *Asterina gibbosa* and the development of *Asterias pallida* are in all essential points identical in character. I have submitted my own sections to reëxamination, after reading Dr. Goto's paper, and find them decisive; and I find enough imperfection in Dr. Goto's methods to more than account for all the differences between us.

My work was based on hundreds of complete series of sections of larvæ fixed by a method which was selected, after a long series of trials, as preserving the outlines of the organs with the sharpness of the lines in a steel engraving. I find no evidence whatever that Dr. Goto examined anything comparable to the number of larvæ seen by me, and the method of preservation adopted by him is one of the worst suited for the purpose.

I do not question the accuracy of Dr. Goto's statement as

to the backward displacement of the disk of the young starfish; but I regard the coincidence between the sagittal plane of the larva and the vertical plane drawn through the madreporic pore and the mouth of the adult as an accidental agreement of no deep significance. The backward movement of the disk does not take place to anything like the same extent in *Asterina gibbosa*. It remains true there, in spite of Dr. Goto's denial, that right to left in the larva is nearly dorsal to ventral in the adult. Sections orientated parallel to the frontal larval plane have given longitudinal sections of the stone canal which would be impossible were the relations of adult and larval planes such as described by Dr. Goto.

With regard to the absence of the fixed stage, it is to be regretted that Dr. Goto has given us no information as to how he obtained his larvæ — whether they were reared from the egg, or whether they were obtained by the use of the tow net. Ludwig failed to find the fixed stage in *Asterina gibbosa*, probably because the larvæ were not provided with a suitable substratum; and if Dr. Goto fished his metamorphosing larvæ out of the sea, it is quite conceivable that the time when fixation could occur was past, or that no suitable basis was provided for fixation. Glass is assuredly not such a substance; I never saw an Asterina larva fixed to glass; and it is surely not probable that the brachiolarian arms are developed for no purpose.

I come now to what I regard as one of the most serious points of difference, namely, the meaning of the sac called by me the right hydrocœle. In support of this position, I gave not only a clear account of its appearance unequivocally on the right side of the larvæ, but I also described a number of cases where exceptionally the sac had undergone further development, and produced lobes similar to those formed by the left hydrocœle. Now, Goto has not seen the origin of the structure at all, this occurring at a stage considerably previous to any which he has figured, and his statements as to its later connection with the axial sinus are entirely due to the preservation of his larvæ. Many times in the earlier portion of my work was I tempted to make the same statement before I found out that corrosive sublimate was unsuited for the preservation of these larvæ.

The account given by Goto of the segmentation of the body cavity is also most unsatisfactory, and raises the suspicion of many stages having been missed out. At any rate, he gives no ground whatever for his belief that the "epigastric" cœlom is only a portion of the right posterior cœlom, for he has not shown how he can define the latter space. The stages he describes recall the period in Asterina development when the segmentation of the cœlom, after being formed, has to some extent broken down; and as it is in the highest degree improbable that *Asterina gibbosa* has a more circuitous development than *Asterias pallida*, a reëxamination of this point, based on more abundant material, would probably put a different complexion on the affair.

The criticisms made above with reference to the right hydrocœle apply with tenfold greater force to the origin of the perihæmal cavities. These originate long before Seitaro Goto saw the first trace of them. As to their origin from the cœlom, not the slightest doubt can exist in the mind of any one who has seen a properly prepared section of a metamorphosing Asterina larva. I have figured one of these rudiments under the magnification obtained by a Leitz immersion, putting in the outline of every cell, in Fig. 139 of my paper ('96), and the communication with the cœlom is no dubious slit, but a broad opening. This opening surprisingly soon closes up, and in later stages one could imagine the space to be of mesenchymatous origin, if one had not seen the earlier stages.

I may say definitely that I am very sceptical as to the mesenchymatous origin of any cavity. The mesenchyme is primarily a series of amœbocytes floating in a cavity, which answers retrospectively to the jelly of cœlenterata, and prospectively to the hæmocœle of the higher animals. That these amœbocytes should first coalesce, and then hollow out to form a cavity within a cavity, seems exceedingly improbable, especially when one remembers how easy it is by missing out stages to lose entire sight of the genetic connections of two organs.

In conclusion, I must remark that Seitaro Goto's work is not suited to solve the problems he attacks. Echinoderm larvæ are most difficult objects to handle. Bury himself ('95)

remarks that his early results are unreliable, because he had not imbedded in celloidin, — a statement with which I fully concur, — and it never seems to have occurred to Goto to use celloidin. Osmic acid, again, is the only reagent which will preserve the delicate epithelia so that one can be sure of their actual extent. And Goto used corrosive sublimate mixed with glycerine, an absolutely fatal compound for histology. Again, so far as one can judge, a most insufficient amount of material was used. And there is no subject on which it is so easy to go fatally wrong as organogeny, except an unbroken series of stages be obtained.

We have now reached a stage in embryological research where progress can only be made by the most refined methods, and by the exercise of abundant caution. The day of breaking ground is past. Of course the method of thorough exploration by sections is slow and laborious, and in these days of impatience for quick results it is apt to be shirked; but in my opinion it is the only one which will lead us any farther in our acquaintance with developmental processes.

MONTREAL, October 22, 1898.

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EDITORIALS.

The American *vs.* the British Association for the Advancement of Science. A Comparison. — Comparisons may be odious, especially to the less favored party, but they nevertheless afford the best means for determining shortcomings and the way to improvement. For years we in America have been asking why our Association is so inferior to that of Great Britain; why it is so much less representative of science in the country. Perhaps a detailed comparison of the two Associations will tell us.

The British Association has a membership of about 5000; the American Association of about 2000. The British Association has invested funds, including balance in banks, of nearly $70,000; the American Association has about $6,000. The meetings of the British Association are attended by from 1300 to 4000 paying members and "associates"; the American Association had an attendance at its Detroit meeting, in 1897, of less than 300; at its Boston meeting, in 1898, of about 900 "registered delegates." The published *Report of the British Association* for 1897 contained 1132 pages; the *Proceedings of the American Association* for 1897 had 579 pages, very largely matter of transitory value. The membership of the British Association admittedly and evidently includes practically all the scientific men of Great Britain. In the American Association it is the absence of many of the most important names which is striking. Thus, of the professors of all grades in the twenty principal universities and colleges of the United States, we find that the members of the American Association constituted in physics about 54 per cent; in chemistry, 51 per cent; in geology, 74 per cent; in biology, 27 per cent. The British Association voted, in 1897, $5295 in grants; the American Association, $400. On the other hand, while the British Association expended $2770 in salaries, rent, and office expenses, the American Association spent $2867 on these items. Thus, while the British Association spends 24 per cent of its receipts upon research, ours spends less than 7 per cent; but while our cousins devote 13 per cent of the gross receipts to salaries and office expenses, we spend thus 48 per cent.

Various causes have been assigned for this difference between the two Associations. The small membership and attendance at the

meetings of our Association have been ascribed to the large size of our country. Nearly all the British meetings are held in Great Britain proper, the extreme distance between meeting places on this island being less than 500 miles. On the other hand, the average distance between the successive meeting places of the last seven meetings of the American Association was 767 miles, and the extreme range about 1700 miles. To have attended all the meetings since the one in Boston in 1880, a Boston member must have traveled about 28,000 miles, or one and a half times the distance around the earth at this latitude. Even at a two-thirds fare this would have cost him over $500 in car fare alone, not to mention the discomforts of long journeys. The Boston member who has to economize is fortunate if he can attend two meetings in a decade, and the same is true of the member from Washington or Minneapolis. Thus the great distance between successive meeting places prevents a continuity in the attendance, and this results in loss of interest and interferes with that continuity of endeavor which is essential to the systematic direction of scientific research and the attainment of increased facilities for scientific men. On the contrary, our society seems itself to lack direction. The council of one year votes to cut out all abstracts of papers from the *Proceedings*, and that of the next year rescinds the vote. One year, at one place, a member arouses enthusiasm enough to get a committee appointed to conduct some investigation; and next year, at a place 1000 miles away, nobody hears about the committee, which is discontinued or continued with the "*personnel* the same as last year." There are only two remedies for this state of things; either to break up the Association into Atlantic, Mississippi, and Pacific branches, or else to make the meetings so interesting and valuable that members will attend them despite expense. The latter solution seems to us the best one to work toward.

What can be done to secure this increased interest? This is the vital question. No doubt the determination by the best scientific men of the country to attend the meetings, at the sacrifice of time and money, is the first step. To get this step, however, seems to demand certain reforms. First, the finances should be improved. Cut down salaries, office rent, and office expenses. The American Society of Naturalists, which issues *Records* of nearly fifty pages, pays less than $50 per year for clerical assistance. Why cannot the American Association get along on $1000 a year for salaries? This would release over $1000 for grants for research. The grants would call forth new committees. Formal reports should be required from

each committee, and these should be printed in the *Proceedings*. The value of the *Proceedings* will be thus enhanced and a more general interest will be awakened among scientific men in the work of their Association.

To carry on the enlarged work of the Association, additional funds will have to be acquired. The plan adopted by the British Association, of making visitors and ladies accompanying members pay for the privileges of the meetings, seems to us in every way admirable. The income of the British Association in 1897 was £580 from annual assessments, but £2242 from non-members. Thus the non-scientific contributed to the support of science. Finally, to increase the membership of the Association, a systematic canvas should be made of the scientific societies of the country, to the ends that their quality may be determined; that we may accept, as it were, "on certificate" and without special election, any member of a suitable society; and that these societies may be led to coöperate with the national association in promoting the interests of science in the land.

Zoological Bibliography. — The second report of the committee of the Royal Society upon Zoological Bibliography and Publication has been issued. It contains the following suggestions:

(1) That each part of a serial publication should have the date of actual publication, as near as may be, printed on the wrapper, and, when possible, on the last sheet sent to press.

(2) That authors' separate copies should not be distributed privately, before the paper has been published in the regular manner.

(3) That authors' separate copies should be issued with the original pagination, and plate numbers clearly indicated on each page and plate, and with a reference to the original place of publication.

(4) That it is desirable to express the subject of one's paper in its title, while keeping the title as concise as possible.

(5) That new species should be properly diagnosed, and figured where possible.

(6) That new names should not be proposed in irrelevant footnotes or anonymous paragraphs.

(7) That references to previous publications should be made fully and correctly, if possible, in accordance with one of the recognized sets of rules for quotation, such as that recently adopted by the French Zoological Society.

With all of which the *American Naturalist* is in the closest sympathy. A few comments, however, may be of interest. The second of the

above rules meets with objection on the part of some, who claim that in the case of societies which publish irregularly and at long intervals, it seems wrong to withhold the extras until the whole volume is published. This frequently would result in a delay of months, or even of years. For instance, one volume of the *Transactions of the Connecticut Academy of Arts and Sciences* has been kept incomplete for over a dozen years, awaiting the dilatoriness of an author who has failed to submit the manuscript of an article accepted for publication. All such difficulties, it seems to us, would be obviated by following the course adopted by several societies, among them the Boston Society of Natural History and the American Academy of Arts and Sciences, of issuing each paper separately as soon as it is ready.

In regard to Article 4, we wish that the committee could have gone farther, and have expressed its opinion of a tendency to split up what should form a single article into a number of articles, each with its own heading. We recall one extreme case of a single volume, in which an author had over a dozen articles upon the larval stages of as many different Lepidoptera, each with its own title, and each, by all rules of bibliography, entitled to rank as a separate article, while all might readily be embraced under a single heading. Similar cases abound in the literature of species describing; and their only excuse seems to be that the authors wished to have as many titles as possible to their credit (?) in the bibliographies.

The sixth suggestion is one that if followed will eventually bring to an end a host of trials and tribulations of the systematist. Such names are almost sure to be lost for years. For instance, the late Dr. Haldemann years ago described the crustacean genus Abacura. How many carcinologists know of the description? Then, what shall be done with isolated descriptions in school books? And what with suggestions like the following? In *Science*, Vol. viii, No. 201, p. 613, Dr. Dall, in a notice of Bitners's Lamellibranchs of the trias of St. Cassian, speaks of the preoccupied name Arcoptera and says, "We would suggest that the preoccupied name be replaced by Bittnerella." This occurs in an article which would be apt to be overlooked by the systematist; and again this able conchologist does not actually rename the genus but suggests that it be renamed, as if fully cognizant of the incongruity of time and place.

The Utilization of Desert Areas. — With the increase of our population the extent of our desert areas has constantly diminished through the use of crops adapted to the climate and by irrigation,

so that lands once thought to be uninhabitable are now veritable gardens. One of the most forlorn-appearing regions is the Red Desert of Southwestern Wyoming, which has of late years become an important winter pasture ground for the herds and flocks which feed by summer in the adjacent states. A careful study of the forage plants of the Red Desert, by Prof. Aven Nelson, has just been issued by the Department of Agriculture. It enumerates a large number of salt sages, sagebrushes, grasses, and sedges found in the desert, and figures many of them. The work is important, not merely economically, as giving suggestions for agricultural plants adapted to desert regions, but also as a contribution to the knowledge of the adaptations of desert animals.

Animal Photographs. — Photography is rapidly becoming in a variety of ways one of the necessary tools of a working naturalist, and one of its most important uses is in connection with the production of process figures to illustrate zoological works. The immense superiority of such figures over the conventional woodcuts could not be better shown than in Dr. R. W. Schufeldt's article on "Some Characteristic Attitudes of the Red Squirrel," in the June *Photographic Times*. A zoological text-book, illustrated by such figures as these, would be a pleasure to every lover of animals, as well as a source of information.

We learn that entomological books of all kinds can be imported into Canada free of all customs duties. We, in the United States, have a tariff expressly designed for the protection of ignorance. Books in the English language can be imported duty free only when over twenty years old.

REVIEWS OF RECENT LITERATURE.

Animal Psychology.[1] — Every book which comes to us from the direct and faithful observer of psychical development in the lower animals is doubly to be welcomed: first, for our abiding interest in them which makes every trait of theirs worth knowing for its own sake; and, second, for the light which a study of their nature throws upon the problems of human psychology. Among the latest of these contributors is Prof. Wesley Mills, of McGill University, Montreal, who has been known for a score of years as a successful breeder of dogs and a close student of the habits and development of this and allied species of animals. The book consists of four parts. The first of these comprises a group of essays and addresses upon the methods and the value of Comparative Psychology; the second deals with the phenomena of hibernation, feigning and allied states among animals, and with analogous states obtaining in human subjects; the third and most important section of the work consists of detailed original observations upon the physical and psychical development of animals, supplemented freely by constructive criticism; and in the fourth is added the reprint of a series of discussions upon the nature of instinctive tendencies, which appeared originally in *Science*, 1896. The papers which form the preceding parts of the book were first published in *Science*, *Popular Science Monthly*, and other periodicals, and in the *Transactions of the Royal Society of Canada.*

Professor Mills comes to his work well fitted by years of patient and direct study of animals in his own warrens and breeding kennels; and only such work as his will be of final value for the science of animal and comparative psychology. "Closet psychology," he says, "cannot hope to accomplish much." "He who would understand animals thoroughly must live among them, endeavor to think as they think and feel as they feel, and this at every stage in their development."

At the outset the author makes plain his conception of the impulse to animal study and the nature of its problems. Our interest is based

[1] Mills, Wesley, M.A., M.D., F.R.S.C., etc., Professor of Physiology in McGill University, Montreal, Canada. *The Nature and Development of Animal Intelligence.* The Macmillan Company, 8vo., pp. 300. $2.00.

upon an interpretation of animal nature through the analogy of our own. "We make the world of animal life about us a reflection of ourselves; we spontaneously implant in the bird and the squirrel qualities that are our own. They interest us in proportion as they seem to embody the same thoughts and feelings as ourselves." But this is not the only, nor, indeed, the most important aspect of the study. The science of physiology has grown up almost wholly through experiments performed upon the lower animals; we must apply the same method to psychology; to understand adequately the processes of the human mind, we must study the nature and development of more primitive forms of life. A few words will indicate the relations in which the results of animal psychology have an important bearing upon the questions of human psychology.

It is scarcely a generation since the first psychological laboratories were founded; but in the brief years which have intervened between that time and this there have grown up dozens of such experimental stations, in which skilled observers carry on patient and detailed study of the phenomena of our mental life.

One of the chief difficulties which these experimental psychologists have to solve is the production of a naïve attitude in the subject of the experiment. The mature human being is a mass of ingrained conventions which very greatly transform his original impulses. The primary reaction, the elementary motif, the native trend of desire, the unqualified conviction, are overlaid and disguised by a thousand modifying considerations and restraints imposed upon him by the very form of his social life. He clothes himself in inhibitions as in a garment, and anything which will aid in stripping off this fabric of secondary impulses, and secure for the student a direct observation of the naked tendency, is to be welcomed for the light it throws upon the complex object of his study.

To simplify the conditions under which the mental process takes place, and at the same time to maintain its typical character, is the problem of the psychological investigator; and to fulfill these requirements he goes far afield from the study of the normal adult subject and calls many diverse observers to his aid.

The pursuit of these simpler conditions has gone in two main directions: first, into the province of pathology, where abnormal variations have presented certain elements so heightened in value that the network of ordinary inhibitions has been torn away and the exaggerated impulses can be observed with a directness unattainable in the normal individual; and, second, into the realm of more primi-

tive forms of life, in which the activities common to them and the mature human subject have not been obscured by the counter-play of motives and restraints. Observations in both these fields are accumulating at an immensely rapid rate. Psychiatry has a literature of its own, while the index to works on hypnotism, hysteria, and allied states fills a volume of itself. One can scarcely take up a periodical — popular or technically psychological — without running across either a monograph on this or that phase of child-study, or a notice of some new book on the subject. The habits and peculiarities of the lower species of animals, the character of their sense perceptions, and the nature of their intelligence have long been studied, but rather as classes apart from each other and from man, and not as members of a common genetic group. We need a truly comparative psychology, which, by diligent study of the psychic life of all orders accessible to observation, will seek to show us what the intimate nature of the process of mental development actually is, and to trace back the developed processes manifested in the higher species to their roots in the primitive forms of action and reaction which comprise the mental activities of the more elementary forms of life.

The reflex and subliminal regions of consciousness are full of unsolved problems; instincts, automatisms, whims, and idiosyncrasies, and all such marginal phenomena are things out of the unplumbed depths of our nature upon which biological psychology is bound to pour a flood of light. We need a paleontology of the soul, and the only instrument at hand by which we can probe the region of its vanished growth is that of comparison with the activities of those simpler forms which are now to be found in the child and the lower animal. The child is always with us, and it needs but patience and faithfulness of observation to exploit its nature; but for the study of lower forms of life we need laboratories, of which aquaria and vivaria are but the beginning, in which systematic observation of a wide variety of animal life shall be carried on. Already a move in this direction has been made by more than one university; an increasing number of students are coming to us from zoological museums and laboratories, and many signs point to a rapid and extensive development of biological psychology.

The work which the laboratory of biological psychology shall carry on more systematically and comprehensively, — the patient and sympathetic study of wild and domestic animals, vertebrate and invertebrate alike, — has already assumed great importance at the hands of many individual investigators, who, like our author, look upon the

whole animal kingdom as parts of one genetic scheme, in which the activities and traits of the beasts find their significance not through any fanciful analogy, but because they are the actual prototypes of the mental processes of the human mind itself. "If we regard man as the outcome of development through lower forms, according to variation with natural selection — in a word, if man is the final link in a long chain binding the whole animal creation together, we have the greater reason for inferring that comparative psychology and human psychology have common roots. We must, in fact, believe in a mental or psychical evolution as well as in a physical (morphological) one" (p. 20).

Into the detailed results of Professor Mills's work we cannot enter here, but the problems with which comparative psychology has mainly to grapple can be stated in a few lines.

1. Imagination in animals, the power to frame mental pictures of absent objects.

2. The fact and extent of the power to count and deal with measurable quantities in general.

3. The capacity to generalize upon details and to form abstract ideas.

4. The sense of right and wrong, and the nature of moral sanction among the brutes.

5. Their comprehension of man's various forms of expression and the extent of their power of communication between each other.

6. The homing and migrating instincts of animals and their reappearance in man.

7. The laws of heredity and susceptibility of animals to modification through environment.

Towards the solution of these problems Mr. Mills professes to contribute only material; he is sparing in his deductions and faithful to the fact. "Plainly," he says, "it will be desirable to keep our facts very sharply apart from our explanations. The science of psychology is a very youthful one; that of comparative psychology still more so; and at the present stage of the science any one who contributes a single fact will be a real friend to its progress." The book is chiefly contributory of material, it is true, and such work is long in process, and its conclusions concerning individual functions and species of animals are fragmentary and tentative; but such delving must necessarily precede and underlie all constructive theory.

Mr. Mills's work shows in a marked degree a qualification upon which must be founded all really successful study of animal life;

he is a lover of dumb beasts as well as a student of their ways; and throughout his writing there breathes a frank and open spirit of inquiry, and a fitness of style which increases the acceptability of his work. In its sympathy and kindly appreciation for animals, its modesty, and its sanity and moderation of statement, the book is one of the most hopeful of recent contributions to the study of animal intelligence.

ROBERT MACDOUGALL.

CAMBRIDGE, MASS.

We have received the volume of *Naturæ Novitates* for 1897 from the publishers, R. Friedländer & Sohn, Berlin. This useful work, comprising, as it does, notices of all the more important books and articles of the year in Natural History and the exact sciences, together with valuable Personalia, deserves to be more widely known and used in this country.

GENERAL BIOLOGY.

Animal Grafts. — In the *Sitzungsberichte der Gesellschaft zu Marburg*, Jahrgang 1897, F. Marchand describes several sets of successful experiments in grafting one part of the body upon another part. Thus, in the rabbit he has transplanted the cornea of the eye from one animal to the eye of another, and the transplanted part has taken root, as it were, so that in time the eye appears normal. He has repeated the older experiment of ingrafting the tail of a young rat under the skin of its own back. The tail continues to grow as it would have done in its normal position. The tail makes connections with the blood system of the body in its new location, and these connecting vessels become large enough to carry on the nutrition of the parasitic tail. It is a case of perfect adjustment of the organism to new conditions.

Regeneration of Extirpated Limbs. — Miss Byrnes (*Anat. Anz.*, 1898) has destroyed, by means of a hot needle, the body-wall musculature in young tadpoles at the point where limbs were about to arise. Soon after the operation the cells lying ventral to the wound pushed up and closed it. From this tissue, which normally has nothing to do with forming the limb, the limb arises in normal form and size. [It may be added that this result is less properly called regeneration, which more frequently implies development from a rudiment of the regenerating organ, than regulation, by which a part — the ventral

body-wall — assumes an entirely new function — the formation of a limb — because of the peculiar needs of the organism.] C. B. D.

The Journal of Comparative Neurology [1] begins its eighth volume with a commendable number of original contributions and its usual full series of literary notices. Dr. Alfred Schaper gives an account of the finer structure of the Selachian cerebellum, as shown by chrome-silver preparations. Dr. P. A. Fish describes the brain of the fur seal, *Callorhinus ursinus*, and discusses the nerve cell as a unit. C. L. Herrick contributes three articles: one on the "Physiological Corollaries of the Equilibrium Theory of Nervous Action and Control"; a second "On Cortical Motor Centres"; and a third, in conjunction with G. E. Coghill, on the "Somatic Equilibrium and the Nerve Endings in the Skin." The number of collaborators on the *Journal* has been increased, and now includes Prof. H. H. Donaldson, Prof. L. Edinger, Prof. A. van Gehuchten, Prof. G. C. Huber, Dr. B. F. Kingsbury, Prof. F. S. Lee, and Dr. A. Meyer. G. H. P.

Physiological Archives. — The University of Chicago has published a second volume of *Physiological Archives*, under the editorship of Professor Jacques Loeb. The volume contains seventeen contributions, mostly reprints from articles by Professor Loeb and his pupils, and affords substantial evidence of the activity of the Hull Physiological Laboratory. G. H. P.

We are glad to see that the Macmillan Company announce for early publication *General Physiology; an Outline of the Science of Life*, by Max Verworn, M.D., Ph.D., Professor of Physiology in the Medical Faculty of the University of Jena. Translated from the second German edition and edited by Frederic S. Lee, Ph.D., adjunct Professor of Physiology in Columbia University.

ANTHROPOLOGY.

Observations on the Muscular Variations of the Human Races. [2] — Notwithstanding the exhaustive studies that have been devoted to the human skeleton, there yet remain many unsolved problems pertaining to the relation of culture, environment, and race to the

[1] *The Journal of Comparative Neurology*, vol. viii, July, 1898, Nos. 1 and 2.

[2] Chudzinski, Th. Observations sur les variations musculaires dans les races humaines, *Mémoires de la Société d'Anthropologie de Paris;* I, ii, Fasc. ii, 1898.

form of the skeleton. Much less is known concerning the effect of these factors upon the more perishable portions of the body. The material is not agreeable to handle and the opportunity comes to but few. Dr. Théophile Chudzinski improved the opportunity which presented itself to him during the period of twenty years in which he was connected with the laboratory of the School of Anthropology of Paris, and published the results of his indefatigable investigations in the field of comparative myology in a number of papers upon the variation of the muscles in the different races. From the vast quantity of laboratory notes and manuscripts which he had accumulated Professor Manouvrier announces in an introductory note that a number of papers are to be published soon. The present memoir deals with thirty-five muscles, chiefly those of the upper extremities. The known variations of each muscle are considered with frequent allusions to dissections by the author other than those represented in the succeeding tables; then a section is devoted to the comparative anatomy of the muscle; this is followed by a presentation of the "Anthropological" characters, with tables showing the mean, maximum, and minimum dimensions, insertions, etc. The "Conclusions" briefly recapitulate the facts presented in the case of each muscle. The use of a different kind of type in these summaries would have enhanced the value of the work. It is not claimed that the results are final, nor is the classification of the subjects dissected, as *noire* or *jaune*, above criticism. However, the memoir contains a rich store of information for the somatologist.

Publications of the Société d'Anthropologie de Paris. — The publications of the French society consist of its well-known *Bulletins* and a series of original *Memoirs*. In No. 1, Vol. ix, of the *Bulletins* appears a reprint of the constitution and by-laws of the society, together with a list of its members. Four prizes, amounting to 4500 francs, are awarded by the society for papers upon anthropological subjects; neither "sex, nationality, nor profession" debars any one from competition.

In the first article of the constitution it is stated that the object of the society is the "scientific study of the races of mankind." By this definition the scope of its operations is so broad that we turn to its publications to learn how this study is carried on. The number of the *Bulletins* mentioned contains nine articles, including abstracts, three of which are upon somatological, and the remainder upon archæological subjects. Important ethnographic papers are occa-

sionally published in both *Bulletins* and *Memoirs*, but the field of activity of the society is, for the most part, limited to two divisions of the science of anthropology.

Professor Manouvrier, in *Bulletin* No. 2, Vol. ix, reports the existence of a remarkable case of ichthyosis in a peasant forty-seven years of age, from the Department of Lot-et-Garonne. Nearly the entire surface of his body is covered with scales, generally quadrangular, and in places imbricated. The deformity is congenital and has not affected the health of the subject. That it is a case of atavism is suggested, but the supposition cannot be proven. M. Zaborowski gives an interesting account of the affinities of the tribes of Western Siberia, particularly of the ancient peoples whose skeletons are found in the dolmens of that region. It is a relief to note that a very moderate number of measurements is considered sufficient to establish the racial type ; brevity is the soul of craniology. After a careful investigation, in which he rejected the usual indices, M. R. Anthony arrived at the conclusion that the variations of the sternum in the mammalian series can best be represented by an index derived from the breadth and thickness of the presternum. This index is higher and more ape-like in the Australians, Negritoes, and Hottentots (above 40) than among Europeans (32.4). Dr. Adolphe Bloch presents the results of his investigations upon the number of phalanges in the fifth toe of the human foot. He states that the anomaly of two phalanges instead of three occurred, according to Pfitzner, in 37.2 per cent of the 799 feet examined. Dr. Bloch's observations upon a smaller series resulted in the discovery of so large a number of cases that the toe with two bones seemed to be the normal one, and the toe with three phalanges the anomaly. He inclines to accept Testut's opinion that the reduction in the number of phalanges in the fifth and other toes is a progressive modification due to the adoption of the erect attitude by man.

FRANK RUSSELL.

ZOOLOGY.

The Birds of Indiana. — The previous catalogues of Indiana birds having become antiquated and out of print, Mr. Amos W. Butler has given us the results of twenty-one years of study of the birds of his native state in a stout volume of 673 pages,[1] forming a

[1] Butler, Amos W., Indianapolis, Ind. *The Birds of Indiana.* A descriptive catalogue of the birds that have been observed within the state, with an account

useful handbook, containing keys for the determination of the species, as well as brief but sufficient descriptions of each bird undoubtedly observed within the confines of the state. By strictly following the nomenclature adopted by the American Ornithologists Union, he has avoided the necessity of synonymic lists, and on the whole the technical matter has been reduced with commendable discretion to the smallest practicable compass, thus leaving ample space for observations regarding distribution, habits, economic importance, etc. The technical matter is chiefly compiled from well-known manuals, for which due credit is given, and calls for no comment here, except that the compilation seems to have been done with care and judgment.

The chief value of the book lies in the original observations of the author, and the student will here find a rich store of facts to ponder upon. The agricultural man will learn which birds to regard as friends, and which to treat as enemies; he will find many of his prejudices and superstitions combated, but he has been given large and convincing series of facts ascertained by the author, or gathered by him from other reliable sources, notably from the publications of Dr. Merriam's division of ornithology of the United States Department of Agriculture. The lover of the feathered tribes will find many interesting bits of information concerning the habits of his favorites, and special attention has evidently been paid to the calls and songs of the various species. Young beginners and local ornithologists will find the book a reliable guide among their specimens, and sportsmen have an easy means of identifying the contents of their bags. Ornithologists of wider sphere will find it a treasure of detailed facts relating to distribution and migration, which it will repay them to exploit.

Ornithology is even now looked upon by many zoologists more as a pleasant pastime than a serious science, more fit for an amateur than for a working natural philosopher. It is true that ornithology, perhaps more than any other branch of zoology, is burdened with the ills resulting from a large number of irresponsible amateurs, but I think it is equally true that no branch, on the other hand, is indebted to non-professional co-workers for most valuable help to the same extent as ornithology. The book before us not only illustrates this point to perfection, but a perusal of it will also convince the most sceptical that in exactness and methods the ornithology of to-day is

of their habits. *From the 22d Report of the Department of Geology and Natural Resources of Indiana, 1897. W. S. Blatchley, State Geologist*, pp. 515–1187.

not behind the other sections of descriptive zoology; nay, it may even be said in truth that it has shown the way to many of them. But if the technical part of this science is not behindhand, certainly the object itself is not inferior in general philosophic interest to that of any other branch of zoology. The study of birds has helped throw light on many obscure questions in geology, paleontology, and evolution, and the sooner the ornithologist is enabled to settle all the little questions of detail, which seem so unimportant to outsiders, the sooner will he be able to contribute to the solution of the higher problems. The avifauna of this country is probably better known than that of any other area of even approximately similar extent, yet much is to be done, and in bringing forward its share of the material the book under review is valuable to the most advanced student. Take the case of Kirtland's warbler (p. 1070), for instance. The history of this bird as there set forth is most suggestive and extraordinary. The first specimen was taken at sea, off Abaco Island, one of the Bahamas, in 1841, and the species has since been discovered to pass the winters in that archipelago. Ten years later a specimen was captured near Cincinnati, Ohio, by Dr. Kirtland, for whom Professor Baird named the species. Mr. Butler enumerates twenty specimens as having been seen or killed in North America since then; all these were observed during the spring or fall migrations with possibly one exception, and outside of its winter haunts this species has not been met with elsewhere. Where does it pass the summer; where does it lay its eggs and rear its young? Nobody knows, and we have only surmises. If we draw a straight line from the northwestern end of the Bahamas to the middle of the state of Michigan, we will see that the localities where specimens of this curiously rare bird have been found are either situated nearly on this line or close to it on both sides, *viz.*, in South Carolina, Ohio, Indiana, and southern Michigan; while a few others have been taken at points considerably off the line, as near Minneapolis, St. Louis, and Washington, D. C. These are all the facts which the ornithologists, in spite of the utmost efforts, have been able to bring together during a search of nearly fifty years! And what do these facts suggest? First, let it be stated, that nearly all the facts have been brought to light by non-professional observers; next it may be noted that as ornithology became more popular, and amateurs more numerous, the observations also became more frequent; it is also highly suggestive that the country between South Carolina and Ohio, through which the annual migrations of this bird almost to a certainty take

place, is less frequented by amateur ornithologists than probably any other part of eastern North America; the inference then is pretty plain that if we had more of the right kind of amateurs we should probably also have more facts with which to answer the question — where does this bird summer, and where lies its exact migration route?

The importance of this question is very great, for, seemingly at least, the distribution of this warbler suggests a migration route almost unique. Yet, if we accept as our working theory of migration the only rational one which has been offered to the present day, *viz.*, Palmén's, that the annual migration route of a species indicates the way by which it originally immigrated into its present breeding home, how are we going to explain the apparent uniqueness of the route of *Dendroica kirtlandü?* It must not be forgotten that it is extremely difficult, if not impossible, to trace the individual migration paths of a homogeneous species covering a large area and occupying a multitude of routes between its vast summer habitat and its equally extensive winter quarters, and that, even in cases where the birds of a widely distributed species have evolved slightly differentiated forms traveling on their own migration routes, it requires the keenest power of discernment in the sharpest bird expert to trace these routes. How can we tell but that many of the homogeneous species occupying the whole area of eastern North America do not in part follow a route similar to that of Kirtland's warbler? It will now be seen how desirable it is to trace step by step the progress of this species from the Bahamas to Michigan, and possibly beyond. Here is a species so very strongly differentiated as not to be mistaken for any other, and so limited in numbers that it probably follows only a single narrowly limited route. When we shall have solved this problem we shall also know a good deal more about the road by which in past ages part of our fauna entered their present habitat.

There remain only a few words to be said about the illustrations in Mr. Butler's book. None, as far as I have discovered, are new, and they would have received no special mention had the selection been good in all cases. We notice with pleasure all the characteristic and accurate bird portraits from John L. Ridgway's pen, furnished by Dr. Merriam's division in the Department of Agriculture, but we must earnestly protest against the presence of a number of antique caricatures — borrowed, it is true, from a book which still periodically appears in the market — which neither illustrate, because it is impossible in most of them to recognize the birds they are

intended to represent, nor lend artistic charm to the page, since they are equally vile, whether meant for pictures only or for ornithological drawings. As startling examples, we may mention the figures on pp. 737, 760, 817, and 997, labeled, respectively, Golden Plover, Passenger Pigeon, Snowy Owl, and Tree Swallow. It is also to be regretted that any of the woodcuts from Brehm's *Thierleben* (pp. 606, 1001) should still be used in an American book, after all that has been written about them. Otherwise the book, which has several interesting introductory chapters and an exhaustive bibliography, is gotten up very well and takes a high rank among similar works.

LEONHARD STEJNEGER.

Trouessart's Catalogue of Mammals, Living and Extinct.[1]— Mammalogists owe to Dr. Trouessart a large debt of gratitude for his Catalogue of Recent and Extinct Mammals, the publication of which is now nearing completion, four of the five fasciculi having already appeared. Considering the magnitude and difficulties of the task, the work is well done; we detect few omissions, and the number of clerical and typographical errors is not greater than is natural to expect in a work of this character. The classification followed is essentially that of Flower and Lydekker's "Introduction to the Study of Mammals," but the order of treatment is reversed, Dr. Trouessart beginning with the Primates and ending with the Monotremes.

No one can be expected to have expert knowledge of all the varied forms of even the class mammalia in this period of rapid advance in the discovery of new forms and of the relationships of hitherto obscurely known types. As the work before us is essentially bibliographical, serving as a systematic index to the species, genera, and higher groups of the mammalia, a few slips here and there in the allocation of species and subspecies, genera and subgenera, can readily be overlooked in view of the utility of this immense undertaking. The specialist will not be misled by the occasional lapses he may detect in the case of groups he has especially investigated, and they can hardly detract from the general usefulness and convenience of a work which will prove an enduring monument to the patience, industry, and scientific acumen of its author.

[1] *Catalogus Mammalium tam Viventium quam fossilium* a Doctore E. L. Trouessart, Parisiis. Nova Editio (Prima completa). Berolini: R. Friedländer & Sohn, 8vo. Fasc. i, Primates, Prosimiæ, Chiroptera, Insectivora, pp. 1–218, 1897; Fasc. ii, Carnivora, Pinnipedia, Rodentia, pp. 219–452, 1897; Fasc. iii, Rodentia, pp. 453–664, 1897; Fasc. iv, Tillodontia et Ungulata, pp. 665–998, 1898.

About 6000 species and 1183 genera, with probably nearly as many subspecies and subgenera, are marshaled in due order in the first four fasciculi aside from synonyms, with full bibliographical references to each, including not only the original place of description but nearly all of the more important subsequent references, including geographical references to localities. The labor involved in this compilation is thus beyond easy conception, and its value to Dr. Trouessart's fellow-workers is inestimable. J. A. A.

Generic and Family Names of Rodents. — Since the completion of that portion of Dr. Trouessart's *Catalogus Mammalium* treating of the Rodents, two important papers have appeared relating especially to the generic and family names of this numerous order of mammals. The first, by Mr. Oldfield Thomas, curator of mammals in the British Museum, is entitled "On the Genera of Rodents: an attempt to bring up to date the current arrangement of the order."[1] The other, by Dr. T. S. Palmer, of the Biological Survey, U. S. Department of Agriculture, is entitled "A List of the Generic and Family Names of Rodents."[2]

As noted by Mr. Thomas, one of the most important previous papers on the same subject was Mr. Alston's "On the Classification of the Order Glires," published in 1876. Mr. Alston was extremely conservative in his views, recognizing only 18 families and 100 genera, as against 21 families and 159 genera admitted by Mr. Thomas. "Of the additional 59 genera," says Mr. Thomas, "just about one-half are formed by the breaking up of old genera, and half are altogether new discoveries." Many old names, however, have had to be changed to bring them into conformity with current rules of nomenclature. On this point Mr. Thomas says: "It is with the greatest regret that I have had to use a good many names unfamiliar to English naturalists, but the evidence in every case is so clear as to leave no room for doubt, and none are mere matters of opinion. Recognizing that the ultimate use of these names is inevitable, I think the sooner a knowledge of them is disseminated the sooner will the intermediate stage of confusion be passed through and done with." Not only are we glad to see so eminent an authority take this sensible position, but we are also gratified to find that he rejects emendations, using names in all cases as originally published by the author proposing them. A seriously disturbing element in the sta-

[1] *Proceedings of the Zoological Society of London*, 1896, pp. 1012–28.

[2] *Proc. Biolog. Society of Washington*, vol. xi (Dec. 7, 1897), pp. 241–70.

bility of names is the tendency, on the part of a few wiseacres, to change names to suit their ideas of correct classical form, often to the extent of a radical transformation of an old name into a practically new one. It seems, for purposes of convenience, far better to extend the law of priority to the form of names as well as to the names themselves, since it is coming to be more and more generally accepted that a name is merely a convenient handle to a fact and need have no necessary significance. While it is desirable that all new names should be correctly formed, it is not necessary nor even desirable that old names should be discarded on account of faulty construction, nor even emended to suit our ideas of propriety.

Mr. Thomas divides the Rodents, as has long been customary, into two suborders — Simplicidentati and Duplicidentati, the latter consisting of the Hares and Picas, and the former including the rest of the order. The Simplicidentati are divided into five superfamily groups — Anomaluri, Sciuromorpha, Aplodontiæ, Myomorpha, Hystricomorpha. The families admitted in addition to those recognized by Alston are Bathyergidæ, Heteromyidæ, Erethizontidæ, and Pedetidæ. The American Porcupines are for the first time distinguished as a family from those of the Old World. References are given to the place of original description of the genera, but not for the higher groups; subgenera and synonyms are not included in the list.

Dr. Palmer's paper admirably supplements Mr. Thomas's, inasmuch as it gives references for the higher groups and includes subgenera and synonyms. The references here given for the higher groups are a great convenience, as they are generally omitted; a glance at Dr. Palmer's list, however, shows which among several names for the same group has priority. Dr. Palmer's paper is further "an attempt to bring together *all* the names, generic and subgeneric, ever proposed for Rodents." Reference to the place of publication is omitted, only the name of the author, the date of publication, and the type species, whenever determinable, being given, or in the absence of a type species all the species originally referred to the genus. Great care has been taken to give the actual date of publication, as distinguished from the ostensible or apparent date, wherever possible, as is the case in a large number of instances.

According to Dr. Palmer, the present list contains more than 600 generic and subgeneric names, or more than twice the number given by Marschall in 1873, and comprises about "15 per cent of the entire number of generic and subgeneric names ever proposed for mammals." The arrangement is strictly alphabetical as regards not

only the families but the genera and subgenera within the families, except in the case of the Muridæ, with its 200 names, which are alphabetized under the subfamilies.

These three lists — Dr. Trouessart's, Mr. Thomas's, and Dr. Palmer's — supplement each other admirably, the omissions in one being supplied by the other two, so that the work of the specialist in this group has now become greatly simplified and lightened as regards its nomenclatorial side. J. A. A.

A New Human Tapeworm. — In 1896 Prof. H. B. Ward, of the University of Nebraska, announced the discovery of a new human tapeworm, two specimens of which had been received by him from a Lincoln, Nebraska, physician. The new species was described as possessing characters in many respects intermediate between those of the two well-known species of Tænia found in man (*T. saginata* and *T. solium*), and for that reason was named by Ward *Tænia confusa*.

Only one of the two specimens received by Ward bore the scolex or head, which was "remarkably small," and unfortunately was detached by him for more careful study than was possible in its natural position. Ward's published description and figure of this scolex, he admits, would answer well for that of Dipylidium, and he is not now himself certain that he did not confuse the scolex, in the course of its preparation for microscopic examination, with that of a Dipylidium. That important portion, therefore, of the description of the new species, which concerns the scolex, must be held in abeyance until additional specimens are obtained.

Michael F. Guyer, a pupil of Professor Ward, in a recently published paper,[1] gives a detailed account of the anatomy of the new species as made out from a careful study of the specimens received by Ward in a headless condition and, unfortunately, none too well preserved.

Guyer finds that the proglottides of the new species are about as numerous as those of *T. solium*, but much longer and narrower, making its total length two or three times that of *T. solium*, and about the same as that of *T. saginata*, which, however, bears nearly twice as many proglottides. The branches of the uterus, one of the most conspicuous characters of a ripe proglottis, number from fourteen to twenty; in *T. solium* there are from seven to ten branches, and in *T. saginata* from twenty to thirty.

[1] *Zool. Jahr.*, Bd. xi (1898), pp. 1–24, Taf. 28.

Calcareous bodies are few in number, as in *T. solium*, but only about one-tenth as large; they are of about the same dimensions as those of *T. saginata*, but much less numerous.

Other characters enumerated by Guyer might be mentioned, in respect to which *T. confusa* occupies an intermediate position between *T. saginata* and *T. solium*. How widely the new species occurs is, of course, unknown. It may be that the existence of this intermediate species has merely been overlooked heretofore; another possibility suggests itself — can it be that these apparently rare specimens are hybrids between *T. solium* and *T. saginata*, a thing, to be sure, unheard of heretofore, but not for that reason impossible. W. E. C.

Zoological Results of Dr. Willey's Collecting Trip.[1] — Naturalists have been looking with eager anticipation for the publication of the results of the three years' expedition of Dr. A. Willey to New Britain, New Guinea, and the Loyalty Islands. These results have now begun to appear in book form. Part I has just come to hand. This volume comprises papers by Dr. Willey on the Anatomy and Development of Peripatus Novæ-britanniæ; P. Mayer, Metaprotella Sandallensis, *n.sp.* [Caprellidæ]; Boulanger, on a Little-known Sea Snake from the South Pacific; Pocock, Report on the Centipedes and Millipedes; Sharp, Account of the Phasmidæ, with notes on the eggs; Pocock, Scorpions, Pedipalpi, and Spiders.

The account of the new Peripatus is perhaps of most general interest. It represents a new-subgenus, Paraperipatus. The ova are small and without yolk, and many embryos, in all stages of development, may occur in the uteri of one female. The embryos lying in the uteri receive nourishment from the mother and are born in a more complete condition than in any other species of the genus. This paper is accompanied by four plates.

The Common Toad. — It is a matter of congratulation for teachers of nature studies in our schools when a well-trained scientific worker will turn aside to put in an attractive form the story of a common object. This has been done by Prof. S. H. Gage, who in a pamphlet of some twenty pages has given an account of the life history and habits of the common toad.[2] The treatment of the subject, while

[1] Zoological Results, based on material from New Britain, New Guinea, Loyalty Islands, and elsewhere, collected during the years 1895, 1896, and 1897, by Arthur Willey, D.Sc., London. Pt. i, Cambridge, 1898. 11 pls. The Macmillan Company.

[2] Gage, S. H. The Life History of the Toad, *Teacher's Leaflets*, prepared by the College of Agriculture, Cornell Univ. (April, 1898), No. 9.

thoroughly accurate, is noteworthy for its simplicity and straightforwardness, and Professor Gage has shown himself a master in this form of composition. Not a little of the success of the pamphlet is due to the illustrations, which show a happy blending of informational and decorative purposes. In one respect only does the text seem open to some criticism; the occasional endowment of the toad with semi-human faculties, while adding to the interest of the composition, is perhaps not wholly consistent with nature. The account is full of suggestions for outdoor studies, and concludes with some appropriate book references for the teacher. G. H. P.

Eyes of Annelids. — The histological structure of the eyes of the free-living marine annelids has been investigated by K. E. Schreiner.[1] In Nereis the retina consisted of pigmented retinal cells and non-nervous supporting cells. In all other annelids examined, Eunice, Hesione, Lepidonotus, Phyllodoce, Asterope, and Alciope, only pigmented retinal cells were observed. This difference the author believes to be of fundamental importance, and he therefore separates Nereis, so far as its eyes are concerned, from the other annelids. The remaining forms then make a natural series, from those with open cup-like eyes, such as are found in Eunice, to the closed vesicular eyes of Alciope. G. H. P.

Mesoplodon on the Norway Coast. — J. A. Grieg records the capture in August, 1895, on the Norway coast, of two specimens of the whale, *Mesoplodon bidens* Sow.[2] Previously this species had been noted in Scandinavian waters only five times. Of one specimen, presumably a female, only the skeleton was obtained; the other, a male, received with the flesh on it, was photographed, and a cast made of it. Both specimens were mounted as skeletons for the Bergen Museum, and Grieg's paper is occupied largely with an account of their osteology. It is reported that when the first one, which was found stranded alive, was shot, it made a noise like a calf being butchered. G. H. P.

Variation in Actinians. — J. A. Clubb has undertaken to examine large numbers of the common species of actinians found in the neighborhood of Liverpool, England, with the intention of ascertain-

[1] Schreiner, K. E. Histologische Studien über die Augen der freilebenden marinen Borstenwürmer, *Bergens Museums Aarbog*, 1897, No. 8.

[2] Grieg, J. A. Mesoplodon bidens Sow, *Bergens Museums Aarbog*, 1897, No. 5.

ing the extent to which they are open to structural variations.[1] The first species reported on is *Actinia equina*, of which 165 specimens were examined. In all these the mesenteries were hexamerous in arrangement, but in seven, or 4.24 per cent, abnormalities were noted in the siphonoglyphs. Four of these seven specimens had one siphonoglyph each; one had three, and two had two, which, however, were not opposite each other. In all cases the siphonoglyphs were accompanied with directive mesenteries, and no such mesenteries were found except associated with siphonoglyphs. This enumeration shows that *A. equina* is far more stable as a species than other actinians, such as *Metridium marginatum*, in which the abnormal individuals far outnumber the normal ones.

G. H. P.

Dorsal Organs of Arthropods. — Nussbaum and Schreiber[2] conclude that the various structures in the arthropods, — some median and others paired, — known as dorsal organs, are cænogenetic in character, and have as their function the reduction of the vitellocyte layer, while in a few cases it produces a secretion which in Idotea fixes the embryo to the chorion. In other cases the secretion may serve as a protective layer between chorion and embryo.

Zoological Notes. — We have already referred to the failure of the Senff expedition to northern Africa in its endeavor to obtain materials illustrating the embryology of the Dipnoan Protopterus. We learn, however, that the University of Cambridge has received a large series of embryos of the closely allied Lepidosiren from South America, which, we hope, may give us a better knowledge of this interesting group.

The United States Fish Commission has been actively engaged in the study of the tile fish, and this year finds them very abundant and extending over a larger range than was known before.

The discovery of a fourth specimen of the rare rail, *Notorius hochstetteri*, in New Zealand, is announced.

Göppert concludes, as the result of detailed studies on the laryngeal apparatus of the Amphibia,[3] that the whole laryngeo-tracheal skeleton — that is the arytenoids and the cricoids, as well as the

[1] Clubb, J. A. The Mesenteries and Œsophageal Grooves of Actinia equina Linn. *Trans. Liverpool Biol. Soc.*, vol. xii, pp. 300–311.

[2] *Biol. Centralblatt*, Bd. xviii (1898), p. 736.

[3] *Morph. Jahr.*, Bd. xxvi (1898), p. 282.

tracheal and bronchial rings — arise from the seventh visceral (fifth branchial) arch, and that the laryngeal muscles arise from the musculature of the same arch. In the same number of the journal, Hochstetter continues his researches on the blood vessels, this time discussing the arteries of the alimentary canal. Bolk describes an abnormal condition in the shorter head of the biceps femoris muscle of the orang, and discusses its bearings upon the morphology of this muscle. Maurer describes the vacuolization of the epidermis of the anura at the time of metamorphosis, while Gegenbaur has some remarks upon anatomical nomenclature, urging the retention of personal names as a guide to the history of the subject, as well as considering the terminations -ideus or -oides.

BOTANY.

A New Text-book on Fossil Plants.[1] — Of late years an increasing interest in the study of plant-fossils has been developed among botanists, especially with reference to the bearing of these fossil remains upon the origin of existing plants.

The great importance of a thorough knowledge of fossil plants in the study of the evolution of plant forms is sufficiently obvious; but, unfortunately, much of the descriptive work upon fossil plants has been done by men who were not botanists, and whose knowledge of living plants was of the slightest. This fact has helped to discredit much of the work in paleobotany, and a great deal of really important work has not, perhaps, received the attention it deserved. There is at present almost hopeless confusion in the nomenclature of fossil plants, names having frequently been given to unrecognizable fragments of more than dubious autonomy, and often enough shown later not to be plant remains at all. It is most encouraging then when we find trained botanists entering the field; men who are really competent to interpret the specimens with which they have to deal, and not so much interested in adding to the already overgrown list of doubtful fragments as in doing something to throw light upon the real affinities of the forms already described.

Professor Seward's thorough training, both as botanist and geologist, has prepared him admirably for the task he has set himself, and it must be admitted that he has acquitted himself in a most satis-

[1] Seward, A. C., M.A., F.R.S. *Fossil Plants*, vol. i. Cambridge, University Press, 1898.

factory manner. Both the botanist and geologist will find his work of the greatest value — quite indispensable, indeed, in a study of the fossil flora of the earth.

The rich collections of the British Museum, as well as other great collections in Britain and elsewhere, have furnished the author with a great mass of valuable materials, of which he has made most excellent use.

The first three chapters of the present volume comprise, first, a comprehensive sketch of the development of the science of paleobotany; a chapter on the relation of paleobotany to botany and geology; and an extremely clear account of the succession and limits of the principal geological periods. A most interesting chapter follows, dealing in a striking way with the factors concerned in the preservation of plant remains. As plants are for the most part destitute of skeletal tissues, except wood, it is not surprising that they have left relatively few remains when compared with animals. This is especially the case among the lower non-vascular plants. Many interesting illustrations are given to show how the process of fossilization is going on at the present day. One of the most striking is the description of the great masses, or rafts of vegetation, drifted out to sea from the mouths of large rivers, like the Mississippi or Amazon. The harder and less perishable structures, like the trunks of trees, and hard seeds or fruits, finally sink to the bottom of the sea, often hundreds of miles away from their original habitat, and, gradually buried in the sediment at the bottom, may in future ages appear as fossils, mingled with various marine forms. It is probable that the occurrence of terrestrial, or fresh-water organisms in fossil beds of marine origin is to be accounted for in this manner.

It is rather startling to learn that not only may such structures as the cuticle and cell walls of the epidermis be preserved, but that delicate parenchyma cells with traces of the contained protoplasm and nuclei can occasionally be recognized in a fossil condition! The most perfect fossils are those in which there has been an infiltration of silicious matter, and such petrifactions often have the tissues so perfectly preserved that microscopic sections reveal most beautifully the details of the cellular structure. It is the study of such sections that has done more, perhaps, than anything else to explain the real affinities of the plants in question.

Chapter V deals with the difficulties and sources of error encountered in dealing with fossil plant remains, and shows how cautious

the investigator must be in drawing conclusions from mere impressions, no matter how clear they may be. The extraordinary external resemblances between unrelated forms is shown by a number of illustrations; *e.g.*, Equisetum, Casuarina, Ephedra.

The second part of the volume is systematic and deals with the fossil forms from the lowest plants, Bacteria and Schizophyceæ, and other simple unicellular organisms, and comprises the Algæ, Fungi, Mosses, and part of the Pteridophytes.

Among the lowest forms, as might be expected, fossils are comparatively few, and often of more than doubtful authenticity. Nevertheless, there are evidences of the existence of Bacteria and blue-green Algæ in very old formations, although in most cases these evidences consist rather in the results of their growth than in the presence of the organisms themselves, *e.g.*, calcareous nodules formed by Cyanophyceæ, partially decomposed tissues attacked by Bacteria.

Among the Algæ, only such forms as have a calcareous or silicious skeleton have left fossils whose nature is unmistakable. Professor Seward is very cautious about accepting the validity of many such doubtful forms as the so-called "Fucoids," for instance, which are merely impressions of extremely doubtful character. There are, however, very perfect fossils whose algal nature is perfectly evident. Of these, the Diatoms, the calcareous Coralline Algæ or "Nullipores," and the calcareous green Algæ, belonging to the Characeæ and Siphoneæ, are the best known. The latter group and the Corallines have played an important part in the formation of certain limestones. As at the present day, in the warmer seas, they grew about the coral reefs which owe their growth to no inconsiderable degree to the activity of these calcareous Algæ. According to Professor Seward, there are reliable evidences of the existence of Corallines as far back as the upper Cambrian and lower Silurian, and the calcareous Siphoneæ were evidently abundant in the ancient seas. The Diatoms are a much more recent development, and no certain evidences of their existence have been found below the secondary formations.

The true Phæophyceæ, or brown Algæ, never develop a calcareous or silicious skeleton, and have left practically no fossil remains that are certainly recognizable. Many casts from the older formations have been attributed to Algæ of this group, but these casts are usually of very doubtful origin. The most probable remains of Phæophyceæ belong to the genus Nematophycus, from Devonian and Silurian deposits. This genus shows some evidences of a structure compara-

ble to that of the existing giant kelps, like Lessonia or Macrocystis. Remains of Fungi and Mosses are too scanty and imperfect to throw much light upon the geological history of these two groups of plants.

Space will not permit of more than a reference to the rest of the contents of the volume in hand. Of the Pteridophytes, the Equisetineæ are fully and clearly treated, and the volume concludes with an account of the genus Sphenophyllum, which is considered to be the type of a class, Sphenophyllales, coördinate with the other phyla of the Pteridophytes. A full bibliography and index complete the volume.

The work may be recommended unqualifiedly as a thoroughly reliable and clear presentation of a most interesting and important subject. It is to be hoped that the second volume may be soon before us.

DOUGLAS HOUGHTON CAMPBELL.

Illustrierte Flora von Deutschland. — The eighteenth revised edition of Garcke's German flora is now at hand. This admirable work is too well known to need description. The new edition, although embodying many minor corrections in keys, plant ranges, etc., maintains in all more important matters the same form as the edition of 1895. Like this, it is illustrated by some 760 block cuts, scattered in the text. These figures, although in some cases a trifle stiff and wooden in general appearance, are very clear and accurate in detail. The work is more than ordinarily interesting to Americans from a sort of parallelism with Dr. Gray's well-known *Manual of Botany*. Both were first issued in 1848, and have alike, in successive editions, received repeated and painstaking revision by their authors. Both follow the De Candollean arrangement of families and what is now regarded as a conservative nomenclature. Both italicize distinctive characters, scatter their specific keys through the text, cite authorities and important synonyms, but omit all bibliography. Both have been exceptionally useful books and still enjoy wide popularity.

The German work describes 718 genera and 2614 species of vascular plants. Its introductory key, still based upon the classes and orders of Linnæus, seems something of an anachronism, but is skillfully managed and certainly lucid. A feature of questionable taste is the use of authorities after vernacular family names. Such expressions as "Campanulaceen Juss.," "Compositen Adans.," and the like, are, it is true, not seriously misleading, yet they are, strictly speaking, inaccurate and therefore to be avoided.

B. L. R.

Moore's Bacteriology.[1] — This little book was originally prepared in the form of mimeograph sheets for the use of students in the bacteriological laboratory at Cornell University, and its statements have consequently been tried in the fires of actual use. Now that these directions have been printed in a simple and inexpensive form, it is to be hoped that they will find their way into many schools and laboratories where bacteriology is studied. No claim is made to completeness or infallibility, but at the same time it would be difficult to find anywhere in the world, in the same number of pages, as many important and useful suggestions. Dr. Moore's courses in bacteriology in the veterinary school at Cornell are among the very best in the country, and this book is to be welcomed as an extension of the influence of a conscientious teacher who is at the same time a competent investigator. The book contains 89 pages, beginning with the cleaning of glassware and ending with the bacteriological examination of water. It is arranged in 59 chapters, designed for as many separate laboratory exercises. Migula's system of classification is adopted. The occasional imperfections and omissions will no doubt be rectified in subsequent editions, of which we trust there may be many.

ERWIN F. SMITH.

Monographie der Myristicaceen.[2] — In few even of the tropical groups of plants have generic lines been so poorly understood as in the Myristicaceæ, the nutmeg family. From time to time attempts have been made to separate from the large and evidently heterogeneous Myristica various independent genera, but hitherto the herbarium materials of the whole family have been so fragmentary, and the difficulty of constructing from them a satisfactory group of genera so great, that even in 1880 it still seemed best to Bentham and Hooker to treat the whole family as a single complex genus.

For some years Dr. Otto Warburg, of the Botanical Museum in Berlin, has been engaged on an exhaustive revision of this confused group, and his completed work, now before us, shows that the task could not have fallen into better hands. The monograph (filling a thick folio of some 680 pages) is of a kind that only Germans have patience to prepare. A liberal space has been allotted to the treat-

[1] *Laboratory Directions for Beginners in Bacteriology.* By Veranus A. Moore, B.S., M.D., Professor of Comparative Pathology and Bacteriology and of Meat Inspection, N. Y. State Veterinary College, Cornell University, Ithaca, N. Y. Published by the author, 1898.

[2] Warburg, O. *Abh. Leop.-Carol. Akad.* Bd. lxviii. Halle, 1897.

ment of the history, affinities, anatomy, morphology, biology, distribution, paleontology, and economic significance of the Myristicaceæ, yet all this is introductory to the elaborate systematic subdivision of the family. Fifteen genera are recognized, of which no less than eleven have been proposed by Dr. Warburg himself. Of these genera, five are American, six African, and four Asiatic. Probably no feature of the work, not even its full descriptions and excellent plates, will add more to its systematic value than the detailed citation of ranges and herbarium specimens.

Like some other compendious German monographs, Dr. Warburg's work is provided with several special indices, which, for convenience, might much better have been united into a general one. B. L. R.

List of Mosses of New Brunswick.[1] — In their recently published catalogue of New Brunswick mosses, Messrs. Moser and Hay enumerate 245 numbered species and varieties, and thirteen unnumbered varieties, with localities appended. About fifty stations are recorded which are not found in Macoun's *Catalogue.* Fifteen "new species" and one "new variety" (six of which are briefly characterized) are included, all of which were described in 1892,[2] or (in three instances) prior to that date.[3] A noticeable lack of uniformity is caused by the omission of the author's name after more than a score of the specific and a majority of the varietal names. Every page contains a few minor typographical errors in scientific names. But even with these defects the list will be found useful. J. F. C.

The Orchids of the Sikkim-Himalaya. — The most sumptuous publications of any botanical garden in the world, not even excepting that at Buitenzorg, are those which emanate from the Royal Botanic Garden at Calcutta. The eighth volume of the *Annals* of this garden,[4] consisting of four parts, put up in two thick portfolios, is devoted to an elaborate monograph of the orchids of the Himalayan range, which for completeness and elaborateness of execution is only to be compared with Dr. King's *Anonaceæ of British India,* Gamble's

[1] Compiled by John Moser and edited by G. U. Hay. *Bulletin xvi,* Nat. Hist. Soc., N. B. (pp. 23–31). St. John, N. B., 1898. (Price 50 cents.)

[2] Macoun. *Catalogue of Canadian Plants,* Part vi. (Musci.)

[3] Ottawa *Naturalist,* vol. iv, and Lesq. and James's *Manual.*

[4] King, G. and Pantling, R. The Orchids of the Sikkim-Himalaya, *Annals of the Royal Botanic Garden, Calcutta,* vol. viii. iv + 342 pp., 448 plates. Calcutta, 1898. Sq. F[4]. £6–6, plain; £9–9, half-colored.

Bambuseæ of British India, or, to make a long story short, the other members of this remarkable series. Like its predecessors, the eighth volume is well printed, and in a portion of the edition certain parts of each plate are colored so as to represent the natural tints of the flowers.

T.

Dr. J. W. Harshberger, who made an incursion into Mexico in 1896, has recently published a paper entitled "Botanical Observations on the Mexican Flora, especially on the Flora of the Valley of Mexico,"[1] in which he gives an annotated list of the plants found in the latter region, prefaced by a short diary and a topographic account of the district. Additional lists are also given for Orizaba and Cordoba. Unfortunately for ordinary use, the catalogue is broken up into a number of separate lists, classified according to habitat, instead of being consolidated into a single enumeration with the ecological information arranged under the several species.

T.

Botanical Notes. — *Apios Priceana* is the name given by Dr. Robinson, in the *Botanical Gazette* for June, to a very interesting plant from Kentucky, discovered by Miss Sadie F. Price, who appears to be making a thorough study of the flora about Bowling Green.

Curtis's Botanical Magazine for October contains a plate of *Amelanchier Canadensis* var. *oblongifolia*, which is sometimes treated by botanists as a distinct species.

The Nepenthes of Australia are discussed by F. M. Bailey in the *Journal of the Royal Horticultural Society* for October. Five cuts, illustrating the leaves of as many species, are given.

A fifth contribution to the knowledge of Melocacti, by the late Professor Suringar, appears in Vol. vi of the *Verslagen* of the Royal Academy of Sciences at Amsterdam.

Opuntia Galapageia is well figured in its natural surroundings in the *Gardeners' Chronicle* of October 8, in connection with a short note on the cacti of the Galapagos Islands, by Mr. Hemsley.

"The Date Palm" is the subject of *Bulletin No. 29* of the Arizona Agricultural Experiment Station, by Professor Toumey, who concludes that southern Arizona has the requisite climate and soil conditions necessary for a profitable cultivation of this tree for the production of fruit on a commercial scale.

[1] *Proc. Acad. Nat. Sci.*, Philadelphia, August, 1898.

A comparative histological study of *Veratrum viride* and *V. album* is published by R. H. Denniston in No. 3 of the current volume of *Pharmaceutical Archives.*

"Economic Grasses" is the title of *Bulletin No. 14* of the Division of Agrostology of the United States Department of Agriculture. The paper is virtually an abbreviated edition of *Bulletin No. 3* of the same Division, and, like that, is well illustrated, a number of good half-tone plates being introduced into the present edition. Professor Scribner appears as its author.

Nos. 9 and 10 of the first Abtheilung of the *Botanische Zeitung* for 1898 contain a study of the male prothallus of Hydropterides, by Belajeff.

In the *Jahrbücher für Wissenschaftliche Bôtanik*, Vol. xxxii, Heft 3, Heinricher publishes a second paper on "Die grünen Halbschmarotzer," dealing with the genera Euphrasia, Alectorolophus, and Odontites.

Rimbach contributes an extensive illustrated article on the growth of rhizomes to a characteristic depth in the soil, to Fünfstücks *Beiträge zur Wissenschaftlichen Botanik*, Vol. iii, Abteilung 1, in continuation of an article in the preceding volume of the same publication on contractile roots and their action.

The possible fiber industries of the United States is the subject of an illustrated article, by C. R. Dodge, in *Popular Science Monthly* for November.

The *Journal of the Royal Horticultural Society* for October devotes something over forty pages to papers by Mr. Burbidge on perfumes, and the plants which afford them, an important part of the collection being a list of books on perfumes.

Twelve of Idaho's worst weeds are described and figured by Professor Henderson in *Bulletin No. 14* of the Agricultural Experiment Station of the University of Idaho. The article is prefaced by an account of the source and mode of dispersal of weeds.

Instructive little handbooks by Dr. Niederlein on the Republic of Guatemala, the State of Nicaragua, and the Republic of Costa Rica have recently been issued by the Philadelphia Commercial Museum. Their scope, while ultimately economic, includes topography, geology, soil, flora, and fauna, so they should be of value to scientific trav-

elers as well as to persons directly interested in the development of the countries of which they treat.

The *Botanical Gazette* for October contains a sketch, by Mr. Norton, of the life of the late Joseph F. Joor, a botanist of Texas and Louisiana.

PETROGRAPHY.

The Lavas of Two Volcanoes in the Eifel. — The lavas of the small volcanoes Hochsimmer and Bellerberg, near Mayen, in the Eifel, were thought to be similar in composition by the earlier geologists. Schottler,[1] however, reports the Hochsimmer lava to be a porphyritic leucitite with phenocrysts of augite, biotite, olivine, and hauyne in a groundmass composed of leucite, augite, and glass. The Bellerberg lavas are augite-andesites, with phenocrysts of augite and biotite in a groundmass composed of augite, plagioclase, a little leucite, and glass. Olivine, hauyne, and quartz are also present in some specimens as porphyritic crystals. The rock approaches in character the tephrites. Large numbers of inclusions are imbedded in the lavas. Some of them are unquestionably endogenous, while others are certainly exogenous. A few consisting of single minerals exhibit no evidence as to their origin. All have been deeply corroded by the action of the enclosing magma. The isolated minerals represented among the foreign inclusions are: hauyne, zircon, corundum, garnet, olivine, feldspar, and quartz. The rock inclusions are fragments of graywackes, slates, quartz-feldspar-aggregates, cordierite and sillimanite-bearing schists, hornblende-schists and biotite-schists, augite-feldspar-aggregates, limestone, and sanidine-aggregates. The limestone inclusions often contain cavities, and in these crystals of chalcomorphite, ettringite, and quartz have been deposited. The action of the magma on the limestone is seen in the formation of feldspars, augite, and glass in the rock surrounding the inclusion, and in the production of wollastonite, quartz, and nepheline in the inclusion itself.

A Sedimentary Granite. — Professor Winchell[2] points out the fact that the oldest rocks in Minnesota are the archean greenstones. The granites which intrude these are believed to be fused sediments.

[1] *Neues Jahrb. f. Min.* etc., Beil. Bd. xi, p. 554.
[2] *Amer. Geologist*, vol. xxii, p. 299.

On the shores of Kekequabic Lake is an augite-granite so closely associated with greenstone-conglomerates (probably tuffs) or greenstone-schists that gradations between the two are thought to have been discovered. Grant, who has studied the same granite, considers it a normal intrusive.

Brush's Manual of Determinative Mineralogy[1] appears in an entirely new edition, — the fifteenth. The book has been completely rewritten by Penfield since the thirteenth edition was published, only the plan of the original having been retained. The contents are entirely new. The present edition differs from its immediate predecessor in the addition of a chapter on the physical properties of minerals and in an entirely new set of analytical tables.

The introductory portion of the volume occupies 244 pages, the tables 58 double pages, and the indices 12 pages. In the index to minerals are found the names of 1015 kinds, a fact that indicates the thoroughness with which the tables cover the field they are intended to cover. There are very few minerals known, except the rarest, that may not easily be identified by following the scheme of analysis indicated by the author.

The chapter on physical properties is devoted mainly to an outline discussion of the principles of crystallography based on the theory of thirty-two classes of symmetry. It treats also very briefly of cohesion, luster, color, and density. All the explanations are clear and the descriptions lucid, so that the student need not have the least difficulty in following them.

There is no question that Professor Penfield's book will rapidly achieve the highest favor among teaching mineralogists. Were it not for the fact that it is somewhat expensive for a book of its kind, it would no doubt soon nearly supplant all other manuals of a similar character among English-speaking students. W. S. B.

Notes. — The interesting group of lava flows for which the name of latite has been proposed by Ransome[2] is carefully described in a recent Bulletin of the Survey. These rocks have already been referred to in those notes. From the discussion of the relations of the effusives intermediate in character between the trachytes and

[1] *Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis*, by George J. Brush. Revised and enlarged, with entirely new tables for the identification of minerals, by Samuel L. Penfield. Fifteenth edition. x + 312 pp., 375 figs. New York, Wiley & Sons, 1898. $3.50.

[2] *Bull. U. S. Geol. Survey*, No. 89, Washington, 1898.

the andesites to one another it appears that the author proposes the name to cover a group of different rock types, and not as the name of any special type. The latites embrace all the effusive forms of the monzonite magmas.

Derby[1] has examined a large number of specimens of kaoline, pegmatites, and muscovitic granites and gneisses from different parts of Europe with respect to their rare components. In many of them he has discovered xenotime and monazite.

Watson[2] has studied the mesozoic diabases near Chatham, Va., and their decomposition products, following the lines laid down by Merrill in the reports of his investigations on weathering. The changes undergone by an olivine diabase in weathering are shown by the first three of the following lines of figures. The fourth line gives the percentage of loss of each constituent in passing from the fresh to the decomposed condition.

	SiO_2	Al_2O_3	Fe_2O_3.FeO	CaO	MgO	Na_2O	K_2O	H_2O		Total.
Fresh rock	45.73	13.48	11.60	9.92	15.40	3.24	.47	.94	=	100.78
Weathered rock	47.87	14.43	11.55	10.45	10.58	3.47	.61	1.82	=	100.78
Decomposed rock	37.09	13.19	35.69	.41	.57	1.75	.33	11.83	=	100.86
	73.64	68.19	0.00	98.68	98.81	82.46	77.31			

The total loss is 70.31 per cent of the original, *i.e.* fresh, rock.

Nitze and Wilkens[3] have given us an excellent account of the methods employed in the gold mines of North Carolina and the adjacent southern states, and good descriptions of the mines themselves. Their report appears as a Bulletin of the North Carolina Survey.

Another Bulletin of this energetic and progressive survey is entitled "Clay Deposits and Clay Industry in North Carolina." It is by Ries,[4] and is one of the best reports on clay that has appeared in this country. It contains the records of numerous analyses, both chemical and mechanical, and a fine description of the special characteristics of clays of economic value.

One of the alterative products of the paleopicrite[5] of Medenbach, near Herborn, is sahlite. It occurs as acicular crystals imbedded in serpentinized olivine and as fringes of needles bordering brown augite, especially on that side of the augite facing olivine grains.

A marekanite obsidian from Corinto, Nicaragua, is mentioned by

[1] *Mineralogical Magazine*, vol. xi, p. 304.

[2] *Amer. Geol.*, vol. xxii (1898), p. 85.

[3] Nitze, H. B. C., and Wilkins, H. A. J. Gold Mining in North Carolina and Adjacent Appalachian Regions, *Bull. No. 10*, N. C. Geol. Survey, 1897.

[4] *Bull. No. 13*, N. C. Geol. Survey, 1897.

[5] Brauns, R. *Neues Jahrb. f. Min.* etc., vol. ii (1898), p. 79.

Peterson[1] as being represented by specimens in the Natural History Museum at Hamburg. An analysis gave :

SiO_2	Al_2O_3	FeO	MnO	MgO	CaO	K_2O	Na_2O	H_2O	Total.
76.68	14.49	1.09	tr.	.84	1.53	1.20	3.92	.36	= 100.11

The rock is a colorless glass containing numerous globulites, etc., arranged in flowage lines.

GEOGRAPHY.

Map of Alaska. — There has recently been published, by the United States Geological Survey, a *Map of Alaska*, on a scale of 1 : 3,600,000. The map is printed in colors, showing the location of gold and coal, and the distribution of principal gold-bearing series. There are also inserted a map of the principal trails to the headwaters of the Yukon and a map of the Klondike Gold Region, both on a scale of 1 : 1,447,000. A descriptive text contains sketches of the geography and geology of Alaska, with an account of the gold fields and the routes to them.

The German Deep-Sea Expedition. — We copy from the *Geographical Journal* the following account of this expedition up to last November :

"The German Deep-Sea Expedition of 1898 started under the most favorable auspices as regards the vessel itself, the arrangements made to adapt it for carrying on deep-sea investigations, and for the accommodation of the members of the scientific staff, and the apparatus and appliances to be used in carrying on the work, which are of the latest and most approved description. The 'Valdivia' is about the same size as H. M. S. 'Challenger'; she steams 10 to 11 knots; the bacteriological, chemical, and biological laboratories and workrooms are commodious and well fitted up; the cabins occupied by the scientific staff are large and handsome, the principal cabin containing a splendid scientific library, including a complete set of the *Challenger Reports*, and there is ample accommodation for storing the marine and other collections made throughout the cruise.

"Prof. Carl Chun, professor of zoology in the University of Leipzig, the originator and leader of the expedition, is accompanied by a staff of eleven scientific men, to assist him in carrying on the various

[1] Brauns, R. *Neues Jahrb. f. Min.* etc., vol. ii (1888), p. 156.

observations, as shown in the following complete list of the members of the expedition:

"A. *Official Members.* — Prof. Carl Chun, leader; Prof. W. Schimper (Bonn), botanist; Dr. Karl Apstein (Kiel), zoologist; Dr. Ernst Vanhöffen (Kiel), zoologist; Dr. Fritz Braem (Breslau), zoologist; Dr. Gerhard Schott (Hamburg Seewarte), oceanographer; Dr. Paul F. Schmidt (Leipzig), chemist; Officer Sachse (Hamburg-American Line), navigator; Dr. M. Bachmann (Breslau), physician and bacteriologist.

"B. *Non-Official Members.* — Dr. August Brauer (Marburg), zoologist; Dr. Otto L. zur Strassen (Leipzig), zoologist; Herr Fr. Winter (Frankfort a/M.), scientific draughtsman and photographer.

"Each member of the scientific staff receives eight marks per day from the government, and their lives are insured for 30,000 marks each in case of death.

"The 'Valdivia' sailed from Hamburg on August 1 last, and is expected to be absent about nine months. The route to be followed may be divided into three portions: (1) From Hamburg round the north of Scotland to the Canary Islands, past the Cape Verde Islands, touching at the mouths of the Kameruns and Congo Rivers and Walfisch Bay, to Cape Town; (2) from the Cape of Good Hope, the Agulhas Bank will be examined, then southwards past Prince Edward Island to the edge of the antarctic ice, returning northwards through the center of the Indian Ocean to the Cocos and Christmas Islands, and thence to Padang in Sumatra; (3) from Padang to Ceylon, thence calling at the Chagos, Seychelles, and Amirante group of islands to Zanzibar, returning home by the way of Sokotra, the Red Sea, Suez Canal, and the Mediterranean.

"On August 4 all the members of the expedition which had sailed to Edinburgh visited the 'Challenger' office there and examined the specimens of deep-sea deposits, etc., brought home by the 'Challenger.' In the evening, after being entertained at dinner by Sir John Murray, the expedition sailed for the Faröe Channel and the Canary Islands. Preliminary accounts of the first dredgings, trawlings, and temperature observations in the North Atlantic had been received in October, the expedition having safely arrived at the Cape Verde Islands. The expedition was to have reached Cape Town in November."

SCIENTIFIC NEWS.

Dr. C. W. Hitchcock, of Dartmouth, is spending the year in making geological explorations in the Hawaiian Islands.

Asa Van Wormer, a wealthy merchant of Cincinnati, has given $56,000 to the University of Cincinnati, to be used for the erection of a fireproof library.

Mr. S. W. Loper, curator of the museum of Wesleyan University, has returned from a very successful collecting trip of seven weeks in the Rocky Mountains. From the Tertiary Eocene beds at Fossil, Wyoming, he obtained 400 specimens of fossil fishes, insects, and plants. In Utah and Colorado he also collected large numbers of valuable fossils. All told he secured about 1300 specimens.

On the twenty-second of October, Toland Medical College was formally transferred with appropriate ceremony to the keeping of the board of regents of the University of California. Toland Medical College was founded in 1863 by Dr. Hugh Huger Toland, who gave $75,000 for that purpose. Eventually Dr. Toland presented the college to the University of California, but until October it was still known as Toland College.

The late Franklin Story Conant, who died of yellow fever contracted in Jamaica, in the summer of 1897, was a graduate of Williams College, in the class of 1893. His classmates have established a prize of $25 annual value, open to students of Williams College, and available towards defraying the expenses of the winner at the Woods Holl Laboratory.

The city of Hamburg has established a station for plant investigations, under the directorship of Dr. Carl Brick. Dr. Ludwig Reh, for some time assistant of Dr. Field, in his bibliographical institute, goes to the new station as zoologist.

Dr. David D. Cunningham, professor of physiology in the Calcutta Medical School, has resigned and has returned to England.

Prof. W. Adolf Bastian, director of the ethnological museum in Berlin, has returned from a trip of two and a half years in Farther India.

James Ingraham Peck, assistant professor of biology in Williams College, died of pneumonia, Nov. 4, 1898, aged thirty-five. He was born at Seneca Castle, New York, graduated at Williams in 1887, re-

mained there a year, and then went to Johns Hopkins for graduate studies. After receiving the degree of Ph.D from the latter institution, he returned to Williams, as assistant in biology, in 1892, and two years later was made assistant professor. During recent years he has carried almost the entire instruction at Williams, and during the summer has acted as assistant director of the Marine Biological Laboratory at Woods Holl. His published papers are upon the variations of the spinal nerves in different varieties of pigeons, the anatomy and histology of pteropods, and upon the plankton food supply of fishes.

Among recent exploring expeditions we notice the following : An English Antarctic expedition, under the patronage of Sir George Newnes, with Borchgrevinck as leader ; Louis Bernacchi, of the Melbourne Observatory, as meteorologist ; Nicolai Hansen and Hugh B. Evans as zoologists and collectors. The government of New South Wales has sent out a deep-sea expedition under the charge of Edgar R. Waite, of the Australian Museum. Its explorations will be confined to the adjacent regions. The Dutch government has assisted in a natural history exploration of the East Indian Archipelago, under the charge of Max C. W. Weber, the professor of zoology in the University of Amsterdam. Frau Weber accompanies him as botanist, while Dr. Jan Versluijs, of Amsterdam, and Herr H. F. Nierstrasz, of Utrecht, will assist upon the zoological side. Prof. P. Knuth, of Kiel, goes round the world on a scientific trip. He expects to spend some time in Buitenzorg, Java. Prof. K. Goebel, of Munich, takes a botanical trip to Australia and New Zealand.

The association of Deutscher Naturforscher und Aertze will meet next September in Munich. Over two thousand members were present at the meeting at Düsseldorf in 1898.

In recent years, as in times past, the University of Oxford has ranked far behind the other large English universities in scientific lines. At Cambridge investigators have been numerous, and they have had abundant facilities for their work, while at Oxford the students were few and the accommodations meager. Oxford loses still further in the recent appointment of her prominent zoologist, Prof. E. Ray Lankester, who goes to London as director of the Natural History Museum at South Kensington.

Charles William Andrews, of the geological section of the British Museum, has returned to London after a fifteen months' trip to Christmas Island.

Recent appointments: Mr. C. A. Barber, government botanist at Madras, India. — Dr. Friedrich Becke, of Prague, professor of mineralogy in the University of Vienna. — Dr. Friedrich Blochmann, of Rostock, professor of zoology in the University of Tübingen. — Prof. Oskar Brefeld, of Münster, professor of botany in the University of Breslau, as successor to Cohn. — Dr. Steven Crowe, tutor in bacteriology in the College of Physicians and Surgeons in San Francisco. — Dr. Frederick E. Clements, lecturer in botany in the University of Nebraska. — Dr. Franz W. Dafert, of Sao Paulo, Brazil, director of the Agricultural Experiment Station in Vienna. — Dr. O. V. Darbishire, lecturer and demonstrator in botany in Owens College, Manchester. — Dr. Dieudonné, privat-docent for bacteriology in the University of Würzburg. —Dr. Hermann Dingler, professor of botany in the forestry station at Aschaffenburg. — Mr. Frederick O. Grover, professor of botany in Oberlin College. — G. T. Hastings, assistant in botany in Cornell University. — G. M. Holman, assistant in biology in the Massachusetts Institute of Technology. — Dr. Honl, privat-docent for bacteriology in the Bohemian University in Prague. — Dr. Hans Hausrath, extraordinary professor of forestry in the Karlsruhe Technical School. — Dr. J. Jablonowski, assistant in anthropology in the Dresden Museum. — Dr. Friedrich Katzer, of the museum at Para, Brazil, geologist of the museum at Sarajevo, Bosnia. — Dr. Georg Klebs, of Basel, professor of botany in the University of Halle. — Dr. Fr. Kopsch, privat-docent for anatomy in the anatomical-biological institute of the University of Berlin. — Dr. Robert Lauterborn, of Ludwigshafen, privat-docent for botany in the University of Heidelberg. — Dr. Hans Lenk, professor of mineralogy and geology in the University of Erlangen. — Dr. Ritter Lorenz von Liburnau, docent in zoology in the Vienna School of Agriculture. — Prof. Lugui Luciani, rector of the University of Rome. — George Grant McCurdy, instructor in prehistoric anthropology in Yale University. — Dr. Albert Matthews, assistant professor of physiology in the Medical School of Tufts College. — W. A. Merrill, assistant in botany in Cornell University. — Dr. B. Moore, professor of physiology in the Medical School of Yale University. — Dr. D. Morris, of the Kew Gardens, head of a department to direct the practical applications of botany in the West Indies. — Dr. Lubomir Niederle, professor of archæology and ethnology in the Bohemian University of Prague. — Dr. E. S. Pillsbury, tutor in bacteriology in the College of Physicians and Surgeons in San Francisco. — Dr. Philipp Počta, professor of paleontology in the Bohemian University of Prague. — James Pollock,

instructor in botany in the University of Michigan. — Dr. C. H. Richardson, instructor in geology and assistant in chemistry in Dartmouth College. — Dr. Adalár Richter, chief of the botanical section of the Hungarian Museum at Budapesth. — Prof. A. F. W. Schimper, of Bonn, professor of botany in the University of Basel. — Dr. Karl Camillo Schneider, privat-docent for zoology in the University of Vienna. — Dr. Paul Schultz, privat-docent for physiology in the University of Berlin. — Julia W. Snow, instructor in botany in the University of Michigan. — Dr. Ernst Stolley, custodian of geology and mineralogy in the museum at Buenos Ayres. — Dr. F. E. Suess, privat-docent for mineralogy and geology in University of Vienna. — Hamilton Timberlake, instructor in botany in the University of Michigan. — Dr. Josef Velenovsky, professor of botany and phytopaleontology in the Bohemian University of Prague. — Prof. W. Waldeyer, rector of the University of Berlin for the coming year. — C. F. Myers-Ward, lecturer in physiology in University College, Sheffield, England. — Dr. Julius Nikolaus Wagner, of St. Petersburg, professor of zoology in the newly established polytechnic institute at Kieff, Russia. — Dr. Werner, docent in zoology in the University of Vienna. — Dr. Heinrich Ernst Ziegler, of Freiburg, i.B., Ritter professor of phylogeny in the University of Jena. — Dr. Zukal, professor of vegetable pathology in the Vienna Agricultural School.

Recent deaths: Professor Arzruni, professor of mineralogy in the École Polytechnique at Aix. — Lugui Balzan, arachnologist and professor of natural history in the University of Paraguay. — Dr. Evert Julius Bonsdorf, formerly professor of anatomy in the University of Helsingfors, aged 88. — Dr. Vicenzo Diamare, assistant in the Institute of Comparative Anatomy of the University of Naples. — Alfred Hart Everett, ornithologist and student of the fauna of the Sunda Islands, June 18. — Dr. C. G. Gibeli, professor of botany in the University of Turin. — Prof. Karl Wilhelm von Gümbel, of Munich, a well-known geologist, July 18, aged 75. — C. W. A. Hermann, formerly a well-known mineralogist in New York, aged 97. — Dr. B. Kotula, botanist. — E. H. Lonsdale, of the U. S. Geological Survey, at Columbia, Missouri, March 7. — João Maria Moniz, botanist, at Funchal, Madeira Islands, July 11, aged 75. — A. Pomel, director of the School of Sciences and the Geological Survey of Algiers in Oran, Algiers. — Dr. H. Präscholdt, formerly teacher of geology and paleontology in the gymnasium in Meiningen, by suicide in an Austrian prison. — Dr. de Windt, geologist, near Lake Tanganyika, Africa.

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